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Analysis and prediction of COVID-19 for EU-EFTA-UK and other countries

Situation report 152

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Foreword

The present report aims to provide a comprehensive picture of the **pandemic situation of COVID-19** in the EU countries, and to be able to foresee the situation in the next coming days. We provide some figures and tables with several **indexes and indicators** as well as an **Analysis** section that discusses a specific topic related with the pandemic.

As for the predictions, we employ an **empirical model**, verified with the evolution of the number of confirmed cases in previous countries where the epidemic is close to conclude, including all provinces of China. The model does not pretend to interpret the causes of the evolution of the cases but to permit the **evaluation of the quality of control measures made in each state** and a **short-term prediction of trends**. Note, however, that the effects of the measures' control that start on a given day are not observed until approximately 7-14 days later.

We show an individual report with 8 graphs and a summary table with the main indicators for different countries and regions. We are adjusting the model to **countries and regions** with at least 4 days with more than 100 confirmed cases and a current load over 200 cases.

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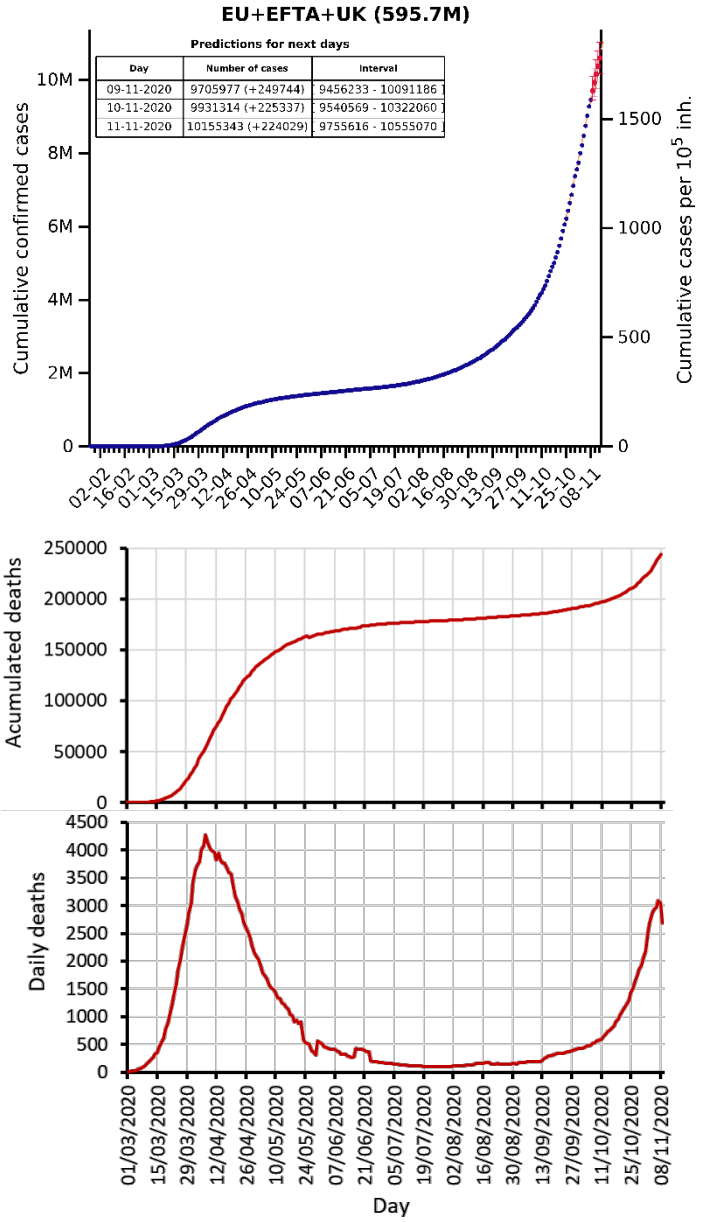
Situation and highlights

Global situation



In the EU + EFTA + UK countries, from the perspective of mortality, the second wave of the pandemic is being scary. The acumulated death is close to a quarter of a million, and we have reached a peak of about 3,000 deaths a day. Such quantities are very large. As we can see in the figures, the daily mortality, at the peak, is approximately 70% of the maximum mortality that was reached in April. Spain, France, Italy and the UK together report almost 1,600 deaths a day, an impresive amount, corresponding to 40% of the maximum they had reached together. It should be borne in mind that during the first wave there were many deaths in nursing homes, institutions that are now much better monitored and controlled. Note also that the treatments to the affected people have been improved, and therefore the progression of the patients is better than in March and April. Therefore, a 40% of mortality with respect to the first peak is a remarkable large value.

Overall there are two notable facts. (1) There are many countries that during the first wave had a very low mortality and are now suffering significant values, for example Poland had a maximum of about 28 deaths per day and is now reaching more than 350; or Czech Republic that it had a maximum of 10 deaths a day and it is now over 180. The dynamics in these two countries has been observed in many other states as well. This allows us to understand that we have recently reached 70% of the maximum that was reached. (2) Some countries have high mortality rates such as the Czech Republic, Belgium, Slovenia, Spain, Poland and Hungary which have reached values of more than 9 daily deaths per million inhabitants, while others have low mortality rates such as Germany, Ireland, Sweden, Denmark and a few others with daily values below 1.5 per million inhabitants.

Mortality reflects the epidemiological situation and the response of countries to it. We are really in a worrying state, we need to maintain or increase the measures to reduce the spread of the pandemic.

Later, we may be able to evaluate which is the real mortality caused by covid-19. There are deaths caused directly by SARS-CoV-2, there are deaths from other diseases of people who have also been infected with the virus, and there are deaths from other pathologies caused by a delay in treatment due to covid-19. All of them are a consequence of the pandemic

Highlights

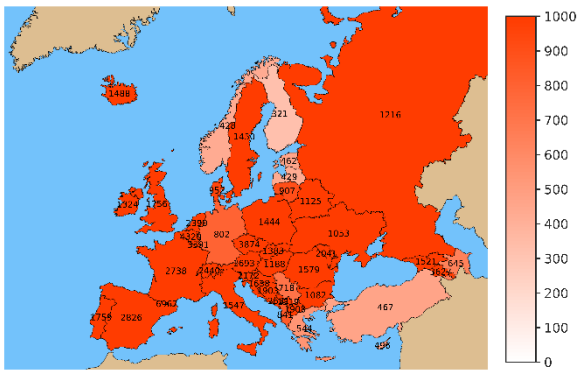
- **Predictions and indexes of those countries that do not report cases this weekend are not reliable (Spain, Belgium, Switzerland, Sweden, Norway, Luxembourg).**
- The list of countries with a ρ_7<1 seems longer than last week, but it should be confirmed on Wednseday once weekend effect is smoothed.
- Only Finland remains with a 14-day cumulative incidence below 100 per 10^5 inhabitants, and Iceland, Latvia, Ireland, Estonia and Norway below 200. On the top-five we find Czech Republic (1460), Luxembourg (1320), Belgium (1285), Switzerland (1250) and Lichtenstein (1110O), all of them with more than 1 % of the population infected right now.

Situation and trends per country

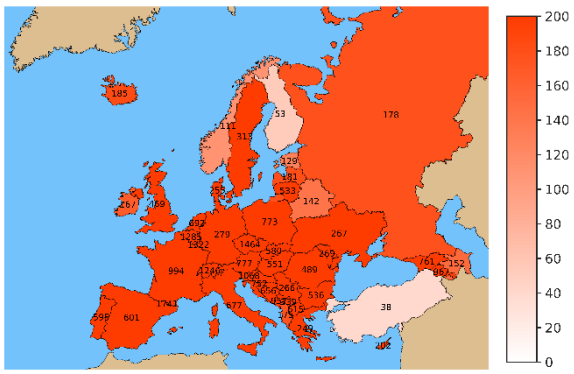
Maps of current situation in EU countries. Colour scale is indicated in each legend.

- Cumulative incidence: total number of reported cases per 100,000 inhabitants
- A_{14}: Cumulative incidence last 14 days per 100,000 inhabitants (active cases)
- ρ_7: Empiric reproduction number
- EPG: Effective Potential Growth ($EPG = A_{14} \cdot \rho_7$)

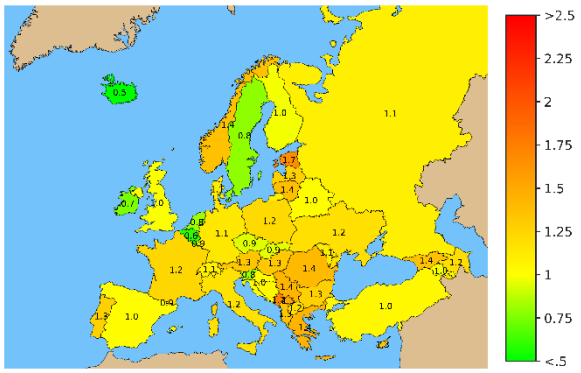
Cumulative incidence



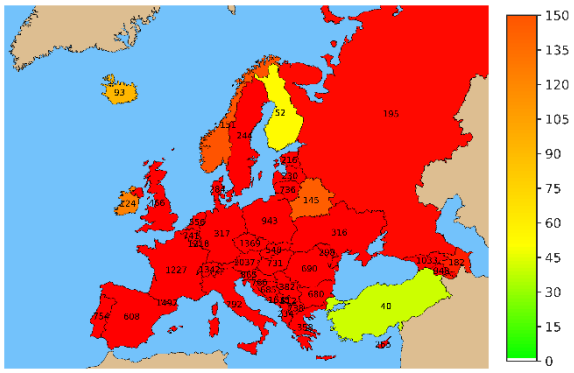
A_{14}



ρ_7



EPG



Tables of current situation in EU countries. Colour scale is indicated in each legend.

Incidence, mortality and epidemiological indexes.

	Reported data						Indexes		
Country	14-day attack rate /10^5 inh.	Active cases (last 14 days)	Attack rate /10^5 inh.	Cumulative cases	Mortality /10^5 inh.	Cumulative deaths	ρ_7 [1]	EPG [2]	Biocom-Cov degree
Czech Republic	1,463.5	156,731	3,873.6	414,828	45.4	4,858	0.94	1,369	9
Luxembourg	1,322.3	8,277	3,591.4	22,481	29.6	185	0.92	1,218	9
Belgium	1,285.2	148,947	4,320.2	500,694	112.6	13,055	0.58	741	9
Switzerland	1,246.0	107,837	2,439.9	211,160	27.8	2,404	1.08	1,342	9
Liechtenstein	1,109.2	423	2,066.2	788	7.9	3	1.19	1,325	9
Slovenia	1,068.4	22,211	2,172.3	45,161	18.4	382	0.81	865	9
France	994.0	648,817	2,738.2	1,787,324	62.0	40,439	1.23	1,227	9
Austria	776.9	69,972	1,693.3	152,508	14.8	1,335	1.33	1,037	9
Poland	773.5	292,737	1,443.8	546,425	20.8	7,872	1.22	943	9
Croatia	751.9	30,867	1,638.1	67,247	19.3	794	1.02	766	9
Netherlands	692.4	118,648	2,390.3	409,573	46.7	7,994	0.80	556	9
Italy	677.0	409,322	1,546.6	935,104	68.5	41,394	1.17	792	9
Spain	601.2	282,700	2,825.7	1,328,832	82.6	38,833	1.01	608	9
Portugal	594.7	60,638	1,758.6	179,324	28.4	2,896	1.27	754	9
Slovakia	579.7	31,652	1,382.8	75,495	6.4	351	0.95	548	9
Hungary	550.9	53,215	1,188.1	114,778	25.8	2,493	1.33	731	9
Bulgaria	536.4	37,271	1,081.7	75,160	24.0	1,665	1.27	680	9
Lithuania	533.2	14,515	907.3	24,699	7.6	207	1.38	736	9
Romania	489.2	94,103	1,578.9	303,751	41.0	7,879	1.41	690	9
United Kingdom	468.7	318,213	1,755.9	1,192,013	72.2	49,044	0.99	466	9
Malta	349.2	1,542	1,594.2	7,039	16.8	74	1.20	420	9
Sweden	313.0	31,608	1,450.2	146,461	59.6	6,022	0.78	244	9
Germany	279.3	234,002	801.9	671,868	13.5	11,352	1.13	317	9
Denmark	254.9	14,765	951.6	55,121	12.8	743	1.12	284	9
Greece	248.6	25,916	544.0	56,698	7.5	784	1.44	358	9
Cyprus	202.3	2,442	495.9	5,987	2.3	28	1.31	265	9
Iceland	184.6	630	1,488.1	5,078	5.9	20	0.50	93	7
Latvia	181.2	3,417	429.2	8,095	5.2	99	1.27	230	9
Ireland	167.4	8,266	1,324.4	65,394	39.4	1,947	0.74	124	8
Estonia	129.2	1,714	461.7	6,125	5.7	75	1.67	216	8
Norway	110.5	5,993	428.4	23,225	5.3	285	1.36	151	8
Finland	53.2	2,949	321.2	17,797	6.5	362	0.98	52	6

Colour scale							
>150.0	Worst	Worst	Worst	Worst	Worst	>2.0	>150
0.0	Best	Best	Best	Best	Best	0.0	0

Positivity indicators, comparing the increase among two last weeks (relative change).

	Cases (this week)			Tests (this week)			Positivity	
Country	Total	Incidence /10^5 inh.	Relative change (%)	Total	Tests /10^5 inh.	Relative change (%)	Value (%)	Relative change (%)
France	289424	431.9	32.0	1403235	2094.0	-2.2	20.6	35.0
Italy	174921	289.8	71.5	1313916	2176.8	18.0	13.3	45.4
Spain	139546	297.3	27.4	1101482	2346.7	2.9	12.7	23.7
Poland	120785	318.1	61.7	448940	1182.3	26.8	26.9	27.5
Germany	103749	125.0	54.4	1358706	1636.6	0.0	7.6	54.4
Belgium	99909	872.1	-4.5	413671	3611.1	-11.3	24.2	7.6
Netherlands	70033	405.2	14.9	178095	1030.5	-12.5	39.3	31.4
Romania	35546	183.1	21.2	204508	1053.4	3.6	17.4	17.0
Austria	26814	302.7	75.5	167926	1895.6	5.6	16.0	66.2
Portugal	25170	244.9	39.4	221266	2153.1	26.0	11.4	10.7
Hungary	19952	204.2	54.0	107033	1095.2	24.0	18.6	24.2
Sweden	17710	173.1	97.5	164742	1610.4	0.0	10.8	97.5
Croatia	15357	376.7	67.0	56386	1383.3	16.0	27.2	44.0
Bulgaria	15282	218.3	80.8	62357	890.8	19.5	24.5	51.3
Slovenia	13030	626.2	47.0	40558	1949.1	2.3	32.1	43.8
Slovakia	9471	173.8	46.2	69754	1279.8	24.2	13.6	17.8
Greece	9259	86.3	83.0	125887	1173.8	-2.2	7.4	87.1
Denmark	6940	119.5	55.3	434949	7491.3	30.3	1.6	19.2
Ireland	5348	109.0	-28.0	88153	1797.5	-23.3	6.1	-6.2
Lithuania	5246	187.7	127.2	63294	2265.2	15.2	8.3	97.2
Luxembourg	4220	687.4	30.2	76608	12479.0	26.4	5.5	3.0
Norway	2331	43.7	112.7	136238	2556.9	26.8	1.7	67.7
Finland	1461	26.5	7.5	63446	1149.8	-34.9	2.3	65.2
Latvia	1427	74.3	32.7	34146	1778.5	3.4	4.2	28.4
Cyprus	922	105.3	-13.4	22619	2582.4	-14.2	4.1	0.9
Malta	667	135.1	-39.0	22566	4572.1	10.7	3.0	-44.9
Estonia	554	41.8	168.9	11852	894.6	17.0	4.7	129.9
Iceland	471	131.9	18.9	12691	3555.0	21.9	3.7	-2.4

Colour scale							
Worst	>150.0	>50%	Worst	0.0	-50%	>10%	>50%
Best	0.0	-50%	Best	>2000.0	>50%	0%	-50%

Table of current situation in some EU provinces. Colour scale is indicated in each legend.

	Reported data						Indexes		
Province	14-day attack rate /10^5 inh.	Active cases (last 14 days)	Attack rate /10^5 inh.	Cumulative cases	Mortality /10^5 inh.	Cumulative deaths	ρ_7 [(1)]	EPG [(2)]	Biocom-Cov degree
Brussels	1,669.7	20,170	5,742.5	69,370	164.7	1,990	0.52	867	9
Bern	925.4	9,578	1,891.9	19,581	17.1	177	1.02	940	9
North Holland	637.5	18,189	2,708.4	77,272	39.2	1,119	0.79	502	9
Wien	553.0	10,491	1,791.0	33,976	19.7	373	1.23	679	9
Lazio	537.1	31,576	1,119.5	65,814	24.0	1,413	1.14	615	9
Lisbon	477.6	13,529	2,177.6	61,690	36.7	1,039	1.11	528	9
Madrid	390.2	25,913	4,682.3	310,936	160.7	10,672	0.91	357	9
Berlin	378.1	14,250	1,051.3	39,624	7.8	295	1.20	456	9
London	313.3	28,079	1,264.3	113,294	NA	NA	0.97	305	9

Colour scale							
>150.0	Worst	Worst	Worst	Worst	Worst	>2.0	>150
0.0	Best	Best	Best	Best	Best	0.0	0

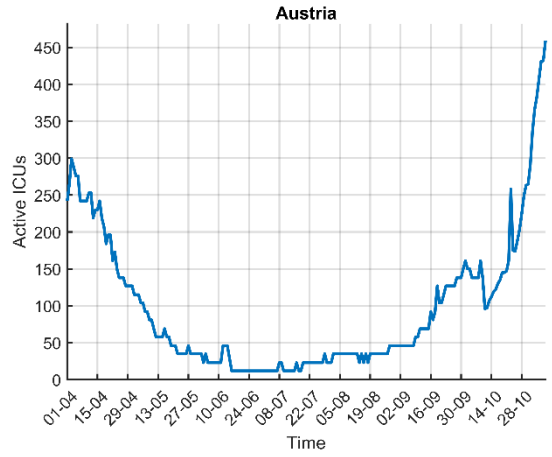
(1) ρ_7 is the average of 7 consecutive ρ, but can still fluctuate. (2) EPG stands for Effective Growth Potential, which is the product of reported cumulative incidence of last 14 days per 10^5 inhabitants by ρ_7 (empiric reproduction number). Biocom-Cov degree is an epidemiological situation scale based on the level of last week's mean daily new cases (https://upcommons.upc.edu/handle/2117/189661, https://upcommons.upc.edu/handle/2117/189808).

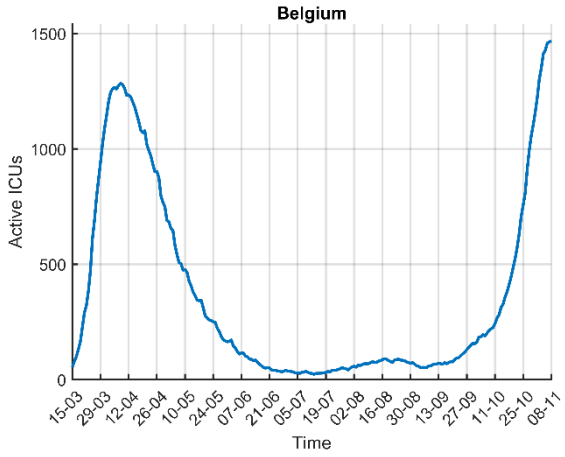
Situation of hospitalisations and ICUs in some EU countries. The analysis is done for those countries that report a historical series with current (active) number of patients in hospitals and ICUs[1]. We provide:

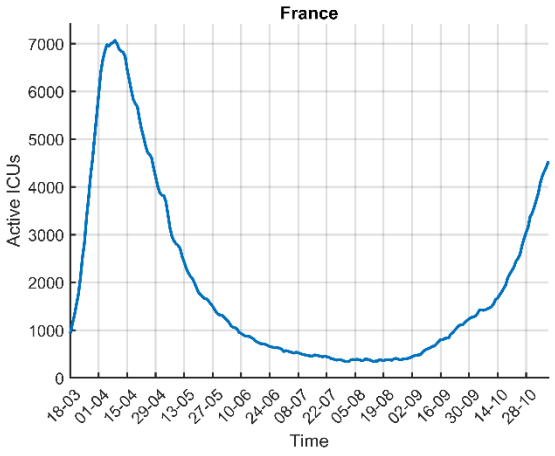
- Current active hospitalisations and patients in ICU per 100,000 inhabitants.
- Current absolute number of active hospitalisations and patients in ICU.
- Rate of occupation of curative care hospital beds by Covid-19 patients (data from Eurostat 2018[2]), only for hospitalisations.
- Current rate of occupation with regards to the maximum Covid-19 occupation reached in this pandemic.
- Weekly increase in Covid-19 patients in hospitals and ICUs.

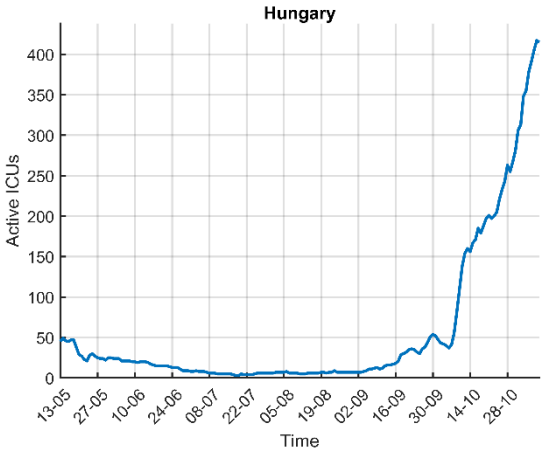
[1] https://github.com/ec-jrc/COVID-19
[2] https://ec.europa.eu/eurostat/databrowser/view/hlth_rs_bds/default/table?lang=en

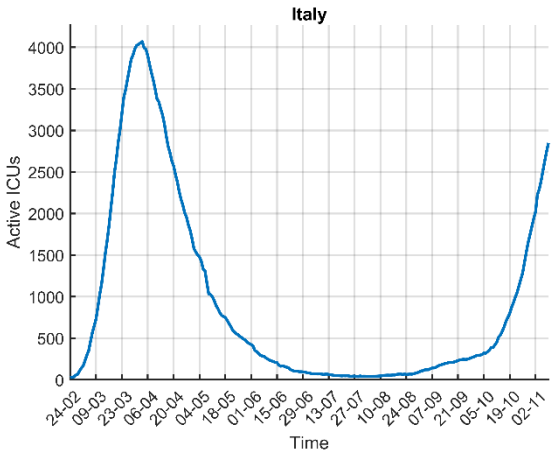
Evolution of of active ICUs in some EU countries.

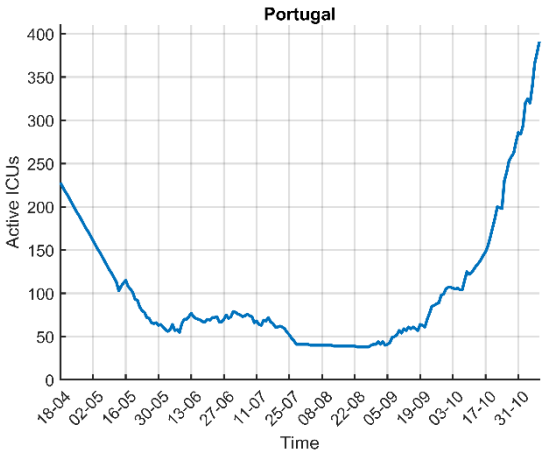




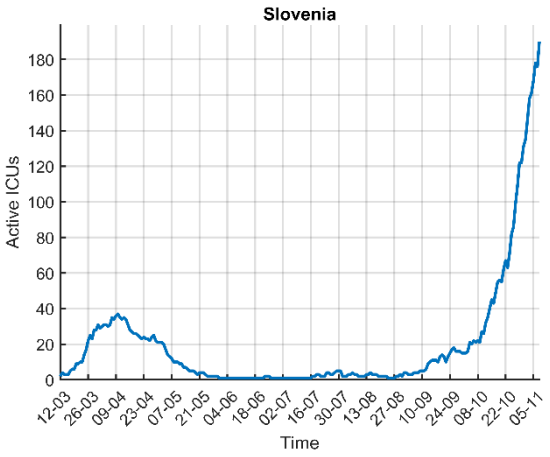









Slovakia
Active ICUs
Time
0
20
40
60
80
100
120
24-04
08-05
22-05
05-06
19-06
03-07
17-07
31-07
14-08
28-08
11-09
25-09
09-10
23-10
06-11


Slovenia
Active ICUs
Time
0
20
40
60
80
100
120
140
160
180
12-03
26-03
09-04
23-04
07-05
21-05
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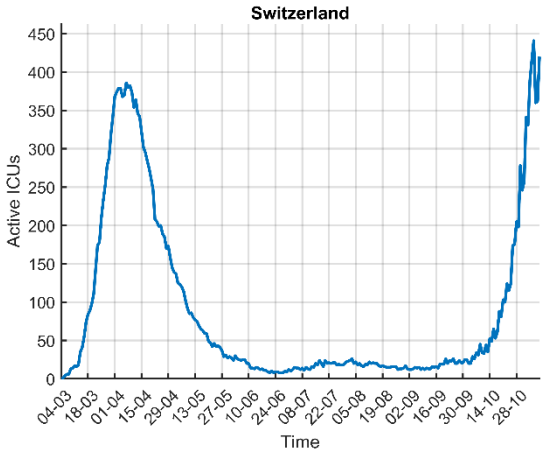
27-08
10-09
24-09
08-10
22-10
05-11


Switzerland
Active ICUs
Time
0
50
100
150
200
250
300
350
400
450
04-03
18-03
01-04
15-04
29-04
13-05
27-05
10-06
24-06
08-07
22-07
05-08
19-08
02-09
16-09
30-09
14-10
28-10

Situation and trends in some European regions[3]

Table of current situation in the Netherlands regions. Colour scale is indicated in each legend.

	Reported data				Indexes		
Region	14-day attack rate /10^5 inh.	Active cases (last 14 days)	Attack rate /10^5 inh.	Cumulative cases	ρ_7 (1)	EPG (2)	Biocom-Cov degree
South Holland	863.0	32,010	3,272.6	121,381	0.76	654	9
North Brabant	800.7	20,378	2,567.5	65,342	0.80	638	9
Utrecht	679.0	8,875	2,713.0	35,459	0.67	458	9
Overijssel	673.8	7,789	2,083.7	24,087	0.76	512	9
North Holland	637.5	18,189	2,708.4	77,272	0.79	502	9
Limburg	603.2	5,272	2,171.7	18,981	0.95	573	9
Gelderland	593.2	12,292	1,952.2	40,449	0.73	431	9
Flevoland	561.7	2,376	1,852.2	7,835	0.90	504	9
Zeeland	419.3	1,606	1,175.5	4,502	0.95	397	9
Drenthe	303.5	1,493	1,230.5	6,054	0.85	257	9
Groningen	242.0	1,411	1,155.9	6,739	0.70	169	8
Friesland	224.8	1,457	1,025.3	6,644	0.76	172	8

Colour scale					
>150.0	Worst	Worst	Worst	>2.0	>150
0.0	Best	Best	Best	0.0	0

Table of current situation in Switzerland regions. Colour scale is indicated in each legend.

	Reported data						Indexes		
Region	14-day attack rate /10^5 inh.	Active cases (last 14 days)	Attack rate /10^5 inh.	Cumulative cases	Mortality /10^5 inh.	Cumulative deaths	ρ_7 (1)	EPG (2)	Biocom-Cov degree
Geneva	2,015.6	10,078	5,298.0	26,490	71.4	357	0.62	1,248	9
Jura	1,941.1	1,417	3,972.6	2,900	60.3	44	0.88	1,713	9
Neuchâtel	1,895.5	3,355	3,884.7	6,876	72.3	128	0.81	1,544	9
Valais	1,891.4	6,563	4,849.3	16,827	80.1	278	0.49	919	9
Vaud	1,654.7	13,221	4,254.8	33,996	56.2	449	0.74	1,229	9
Ticino	1,247.0	4,402	2,943.1	10,389	113.6	401	1.01	1,261	9
Appenzell Innerrhoden	1,012.5	162	2,506.3	401	43.8	7	0.64	647	9
Schwyz	990.2	1,515	2,586.9	3,958	43.1	66	0.76	754	9
St. Gallen	927.6	4,805	2,090.2	10,827	22.6	117	0.84	776	9
Bern	925.4	9,578	1,891.9	19,581	17.1	177	1.02	940	9
Lucerne	853.8	3,364	1,721.8	6,784	12.4	49	0.90	767	9
Appenzell Ausserrhoden	847.3	466	1,863.6	1,025	21.8	12	0.96	814	9
Solothurn	776.8	1,942	1,525.2	3,813	12.0	30	1.40	1,091	9
Glarus	735.0	294	1,652.5	661	37.5	15	1.02	747	9
Zug	727.5	873	1,896.7	2,276	10.8	13	0.98	711	9
Thurgau	710.9	1,962	1,510.1	4,168	17.0	47	0.86	610	9
Zurich	698.8	10,755	1,845.4	28,400	13.6	210	0.75	525	9
Nidwalden	681.4	293	1,553.5	668	14.0	6	1.06	724	9
Schaffhausen	668.9	495	1,385.1	1,025	17.6	13	1.06	707	9
Obwalden	652.6	248	1,547.4	588	15.8	6	1.40	911	9
Graubünden	647.0	1,281	1,660.1	3,287	31.3	62	1.17	755	9
Basel City	629.2	1,164	1,765.9	3,267	30.3	56	0.91	573	9
Uri	608.3	219	1,538.9	554	25.0	9	0.75	455	9
Aargau	587.0	3,980	1,433.9	9,722	13.3	90	0.64	375	9
Basel Country	558.0	1,568	1,346.3	3,783	15.7	44	0.90	503	9
Fribourg	375.5	8,501	675.7	15,298	8.9	201	1.08	405	9

Colour scale							
>150.0	Worst	Worst	Worst	Worst	Worst	>2.0	>150
0.0	Best	Best	Best	Best	Best	0.0	0

[3] https://github.com/ec-jrc/COVID-19/tree/master/data-by-region

Table of current situation in Germany regions. Colour scale is indicated in each legend.

Region	Reported data						Indexes		
	14-day attack rate /10^5 inh.	Active cases (last 14 days)	Attack rate /10^5 inh.	Cumulative cases	Mortality /10^5 inh.	Cumulative deaths	ρ_7 [1]	EPG [2]	Biocom-Cov degree
Bremen	437.7	2,981	1,047.4	7,133	12.8	87	1.27	554	9
Berlin	378.1	14,250	1,051.3	39,624	7.8	295	1.20	456	9
Nordrhein-Westfalen	373.8	67,014	957.2	171,631	13.1	2,355	1.20	449	9
Hessen	365.7	22,915	862.5	54,043	12.1	758	1.14	419	9
Sachsen	349.0	14,227	654.6	26,680	9.9	405	1.56	545	9
Bayern	347.8	45,489	1,023.0	133,808	22.3	2,923	1.41	490	9
Saarland	345.3	3,418	851.1	8,426	20.3	201	1.10	381	9
Hamburg	321.0	6,096	902.5	17,139	16.0	304	1.33	427	9
Baden-Württemberg	306.4	33,914	910.1	100,752	19.2	2,120	1.28	391	9
Rheinland-Pfalz	258.8	10,571	645.1	26,352	7.8	320	1.27	328	9
Niedersachsen	215.7	17,221	580.3	46,322	10.3	823	1.22	263	9
Brandenburg	166.9	4,207	417.3	10,516	8.6	217	1.32	221	8
Thüringen	159.9	3,417	419.4	8,963	10.3	220	1.27	203	8
Sachsen-Anhalt	134.7	2,974	305.0	6,734	4.2	93	1.17	158	8
Schleswig Holstein	120.4	3,480	346.0	10,000	7.0	201	1.05	127	8
Mecklenburg-Vorpommern	104.9	1,689	232.6	3,745	1.9	30	1.21	127	7

Colour scale							
>150.0	Worst	Worst	Worst	Worst	Worst	>2.0	>150
0.0	Best	Best	Best	Best	Best	0.0	0

Situation and trends in other countries

Country	Reported data						Indexes		
	14-day attack rate /10^5 inh.	Active cases (last 14 days)	Attack rate /10^5 inh.	Cumulative cases	Mortality /10^5 inh.	Cumulative deaths	ρ_7 [1]	EPG [2]	Biocom-Cov degree
United Kingdom	468.7	318,213	1,755.9	1,192,013	72.2	49,044	0.99	466	9
United States of America	403.5	1,335,486	3,012.6	9,971,651	71.8	237,572	1.24	502	9
Argentina	335.4	151,593	2,748.4	1,242,169	74.3	33,560	0.87	291	9
Ukraine	267.2	116,842	1,052.6	460,331	19.3	8,450	1.18	316	9
Colombia	251.6	128,002	2,248.1	1,143,887	64.4	32,791	0.93	234	9
Russia	178.5	260,457	1,215.8	1,774,334	20.9	30,537	1.09	195	8
Belarus	142.4	13,456	1,124.7	106,279	10.7	1,007	1.02	145	8
Iran	135.2	113,590	812.6	682,486	45.6	38,291	1.12	152	8
Canada	127.2	48,009	699.8	264,113	27.9	10,522	1.22	155	8
Iraq	116.5	46,842	1,239.5	498,549	28.2	11,327	1.00	116	8
Israel	108.8	9,414	3,692.0	319,562	30.9	2,674	0.92	100	7
Qatar	105.3	3,033	4,658.1	134,203	8.1	232	0.98	103	7
Chile	102.0	19,495	2,728.4	521,558	76.1	14,543	1.01	103	7
Peru	102.0	33,618	2,797.3	922,333	105.8	34,879	1.08	110	7
Brazil	92.2	195,897	2,629.9	5,590,025	75.8	161,106	0.41	38	5
Ecuador	75.2	13,272	991.4	174,907	72.7	12,830	0.75	56	6
Mexico	59.5	76,665	750.6	967,825	73.7	95,027	0.99	59	6
India	47.6	643,698	632.2	8,553,657	9.4	126,611	1.01	48	6
Turkey	38.5	32,454	467.5	394,255	12.9	10,887	1.04	40	5
Philippines	24.1	26,367	361.7	396,395	6.9	7,539	0.96	23	4
Indonesia	17.6	48,004	160.0	437,716	5.3	14,614	1.06	19	4
Saudi Arabia	16.4	5,717	1,007.0	350,592	15.9	5,540	1.04	17	3
Pakistan	7.4	16,237	156.1	344,839	3.2	6,977	1.34	10	3

Colour scale							
>150.0	Worst	Worst	Worst	Worst	Worst	>2.0	>150
0.0	Best	Best	Best	Best	Best	0.0	0

[1] ρ_7 is the average of 7 consecutive ρ, but can still fluctuate. [2] EPG stands for Effective Growth Potential, which is the product of reported cumulative incidence of last 14 days per 10^5 inhabitants by ρ_7 (empiric reproduction number). Biocom-Cov degree is an epidemiological situation scale based on the level of last week's mean daily new cases (https://upcommons.upc.edu/handle/2117/189661, https://upcommons.upc.edu/handle/2117/189808).

Analysis: On the weekend effect on confirmed cases and the resulting oscillations in the empiric reproduction number.

Daily new cases are the basic dataset to analyse the epidemiological evolution and situation of any region or country. The incidence level or its trend can easily be assessed in any daily new cases plot. Nevertheless, almost all regions and countries present a characteristic pattern of oscillations: the wide-known weekend effect[1]. In most of cases, a decrease in new diagnostics is seen every weekend (see Germany or Italy in Figure 1). In some cases, countries do not report data on weekends, which are accumulated on Mondays (Spain in Figure 1). The simplest way to minimize these oscillations is to calculate a 7-day moving average (n_7) that we can assign to the central day of the 7-day period, as follows:

$$n_7(t) = \frac{\sum_{i=t-3}^{i=t+3} n(t_i)}{7}$$

Figure 1 shows the curves of 7-day moving averages of new cases in Spain, Germany, Italy and EU+EFTA+UK. Note that the curve ends just before last 3 days, since last n_7 is assigned to the central point of the last 7-day period.

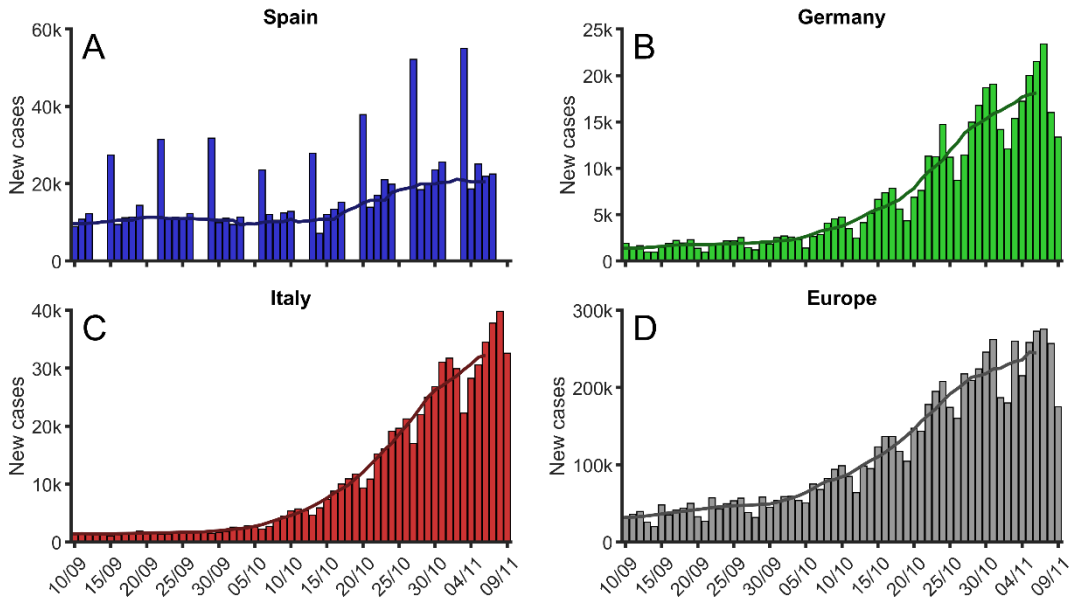


Figure 1. *Daily new cases (colour bars) and 7-day moving average (coloured line) in Spain, Germany, Italy and EU+EFTA+UK.*

Let us analyse the **daily pattern in each country**, i.e., how far from the 7-day moving average the daily values are. We expect, for instance, that weekend values are below the 7-day average curve, while working days are above it. In particular, we are going to assess the **ratio between new cases in a certain day, $n(t)$, and the corresponding 7-day moving average value, $n_7(t)$**. If we group these ratios by each day of the week, we can identify if a daily pattern exists and evaluate it. The closer to 1, the less deviation from the average. The further from 1, the higher the deviation from the average.

[1] https://upcommons.upc.edu/handle/2117/186009

Figure 2 shows the ratio between new cases in a certain day, $n(t)$, and the corresponding 7-day moving average value, $n_7(t)$, for each day of the week in each of the analysed countries during last 5 weeks. **Clustered points for each day indicate a regular daily pattern of under/over reporting**.

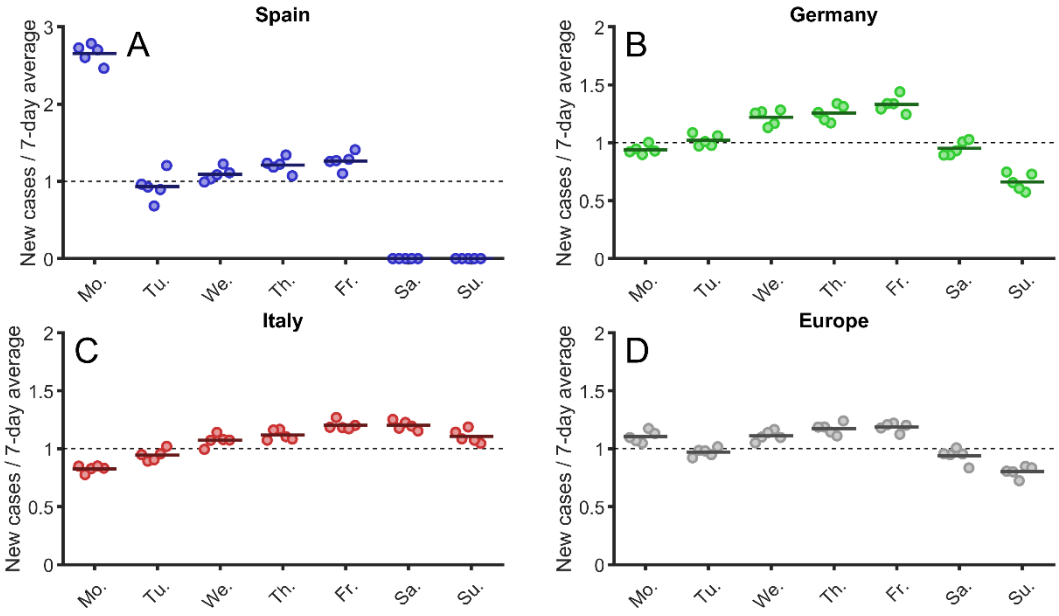


Figure 2. *Reporting ratio between new cases in a certain day, $n(t)$, and the corresponding 7-day moving average value, $n_7(t)$, for each day of the week in Spain, Germany, Italy and EU+EFTA+UK. These ratios are evaluated for last 5 weeks.*

In the case of Spain, the resulting reporting ratios (Figure 2) reflect the same pattern observed in daily new cases (Figure 1): no cases are reported on weekend, and these cases are accumulated on Mondays. In particular, reported cases on Mondays are 2.7 times expected cases. This ratio is lower than 3, thus indicating that the number of new cases in Saturdays and Sundays is also lower than the average.

Weekend effect in Germany is focused on Sundays, which is the day with a persistent and significant under-reporting. The day with highest reporting rate is Friday, while Saturdays and Mondays are around the average. In fact, we observe an increasing trend on the number of diagnostics during the week, from Monday to Friday.

Italy is the country with lowest weekend effect among those analysed in this report. Surprisingly, the day with slightly lower number of reported cases is Monday, probably due to reporting delays. Finally, EU+EFTA+UK also show a clear daily profile, with Sundays at the lower reporting position and Thursdays-Fridays at the higher. It must be stressed that EU+EFTA+UK profile is the result of many different profiles (as many as countries), mainly driven by biggest countries.

At the end of this section we show the daily reporting ratios for all European countries, so that all particular patterns can be observed.

Weekend effect in empiric reproduction number

An essential parameter when we are to evaluate the situation of a country is its reproduction number, which determines if it is in an increasing or decreasing trend, as well as the magnitude of this trend. We use the empiric reproduction number as an indicator of such trends, which **is calculated from the 7-day moving average series of new cases in order to minimize the weekend effect**.

$$\rho_7(t) = \frac{n_7(t-1) + n_7(t) + n_7(t+1)}{n_7(t-6) + n_7(t-5) + n_7(t-4)}$$

Nevertheless, despite the use of n_7 in an attempt to minimize the weekend effect, this effect does not fully disappear if the country is in an increasing or decreasing trend. Let us see this issue with detail. We have simulated the dynamics of the daily empiric reproduction number, $\rho_7(t)$, assuming the daily pattern in new cases shown in Figure 2 and an average reproduction number, $\bar{\rho}_7$.

For instance, we have simulated an increasing trend in Spain with a mean $\bar{\rho}_7 = 1.6$, but we have introduced the reporting ratios given in Figure 2 for calculating the new cases every day. Then, from the obtained series of daily new cases, we have calculated the resulting $\rho_7(t)$ and we have plotted it as the first curve in Figure 3 (red curve for Spain). Then, we have repeated the simulation with slower increasing trends ($\bar{\rho}_7 = 1.4$, $\bar{\rho}_7 = 1.2$), with a constant scenario ($\bar{\rho}_7 = 1$) and with a few decreasing trends ($\bar{\rho}_7 = 0.8$, $\bar{\rho}_7 = 0.6$, $\bar{\rho}_7 = 0.4$). In each simulation, we have computed daily new cases using the ratios in Figure 2 and we have afterwards evaluated the resulting $\rho_7(t)$ dynamics.

Figure 3 shows the obtained $\rho_7(t)$ profiles for Spain, Germany, France and EU+EFTA+UK, assuming the same average values and the particular daily reporting ratios for each country (Figure 2).

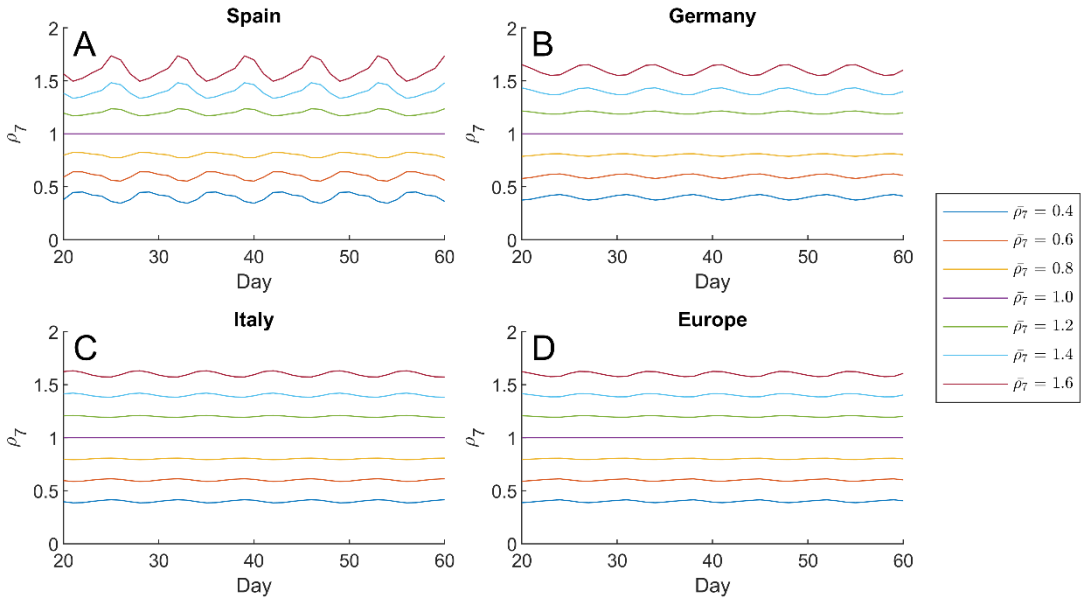


Figure 3. *Simulation of $\rho_7(t)$ dynamics assuming an average value $\bar{\rho}_7$ and the daily reporting ratios for incident cases for each country (Spain, Germany, Italy and EU+EFTA+UK).*

The picture that emerges from simulations is clear: despite using the 7-day moving average series of new cases, the weekend effect is transmitted to the empiric reproduction number whenever an increasing ($\bar{\rho}_7 > 1$) or a decreasing ($\bar{\rho}_7 < 1$) trend is simulated. In particular, we see that:

1) These oscillations are periodical, and their amplitude is higher when $\bar{\rho}_7$ is further from 1.
2) These oscillations only disappear when a constant incidence scenario is assumed ($\bar{\rho}_7 = 1$).
3) These oscillations are higher when the daily reporting ratios are more unbalanced (e.g., Spain).

In previous simulations we have assumed a mean daily pattern (e.g., all Mondays in Spain the cases are exactly 2.7 times those given by the average). Nevertheless, real data series usually show extra daily variability that cannot be associated to a particular cause. **We can include this issue in simulations as random noise**. Figure 4 shows the resulting dynamics in empiric reproduction number, i.e., the effect of mixing daily patterns with random noise.

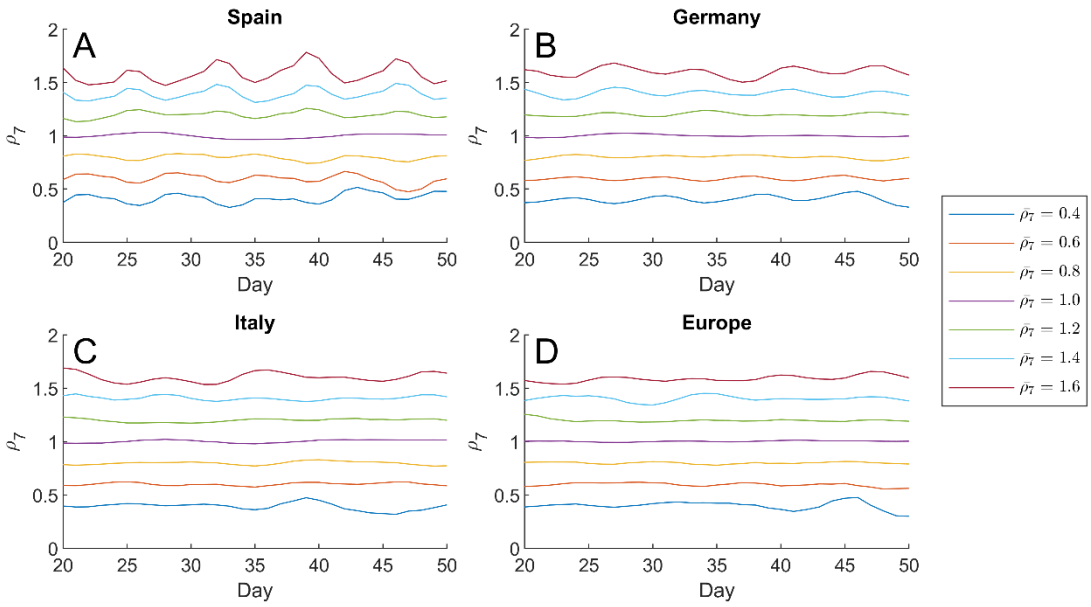


Figure 4. *Simulation of $\rho_7(t)$ dynamics assuming an average value $\bar{\rho}_7$ and the daily reporting ratios for incident cases for each country (Spain, Germany, Italy and EU+EFTA+UK), as well as random noise.*

The resulting dynamics shows the expected mixture between a periodic oscillation and a random noise. For a better interpretation of these results, it is useful to use a boxplot that shows how far are the daily $\rho_7(t)$ values from the average $\bar{\rho}_7$ depending on the kind of trend given by $\bar{\rho}_7$ (constant, increasing or decreasing and its magnitude) (Figure 5).

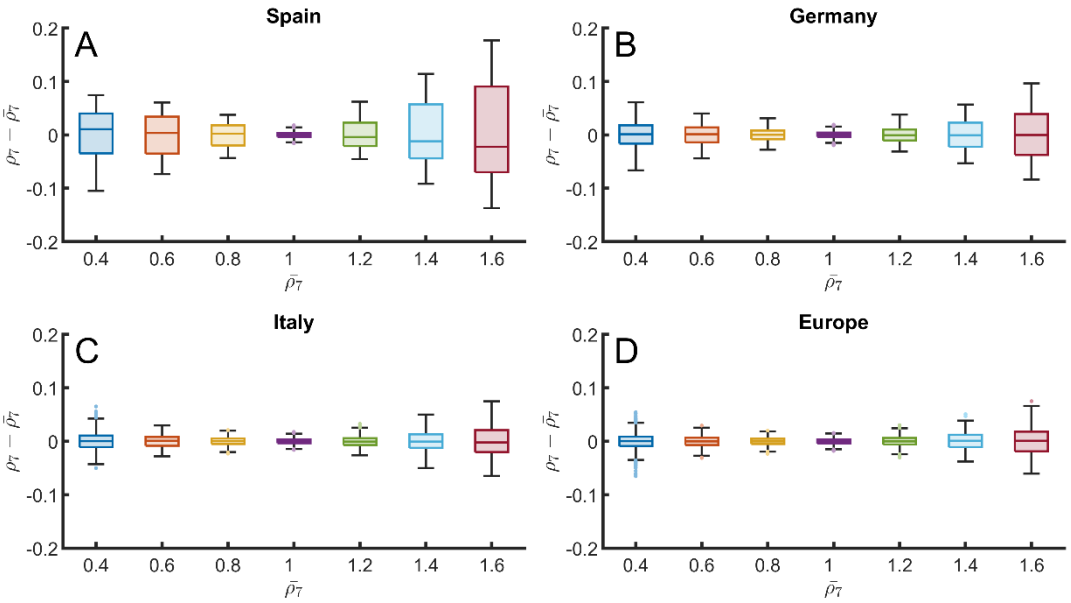


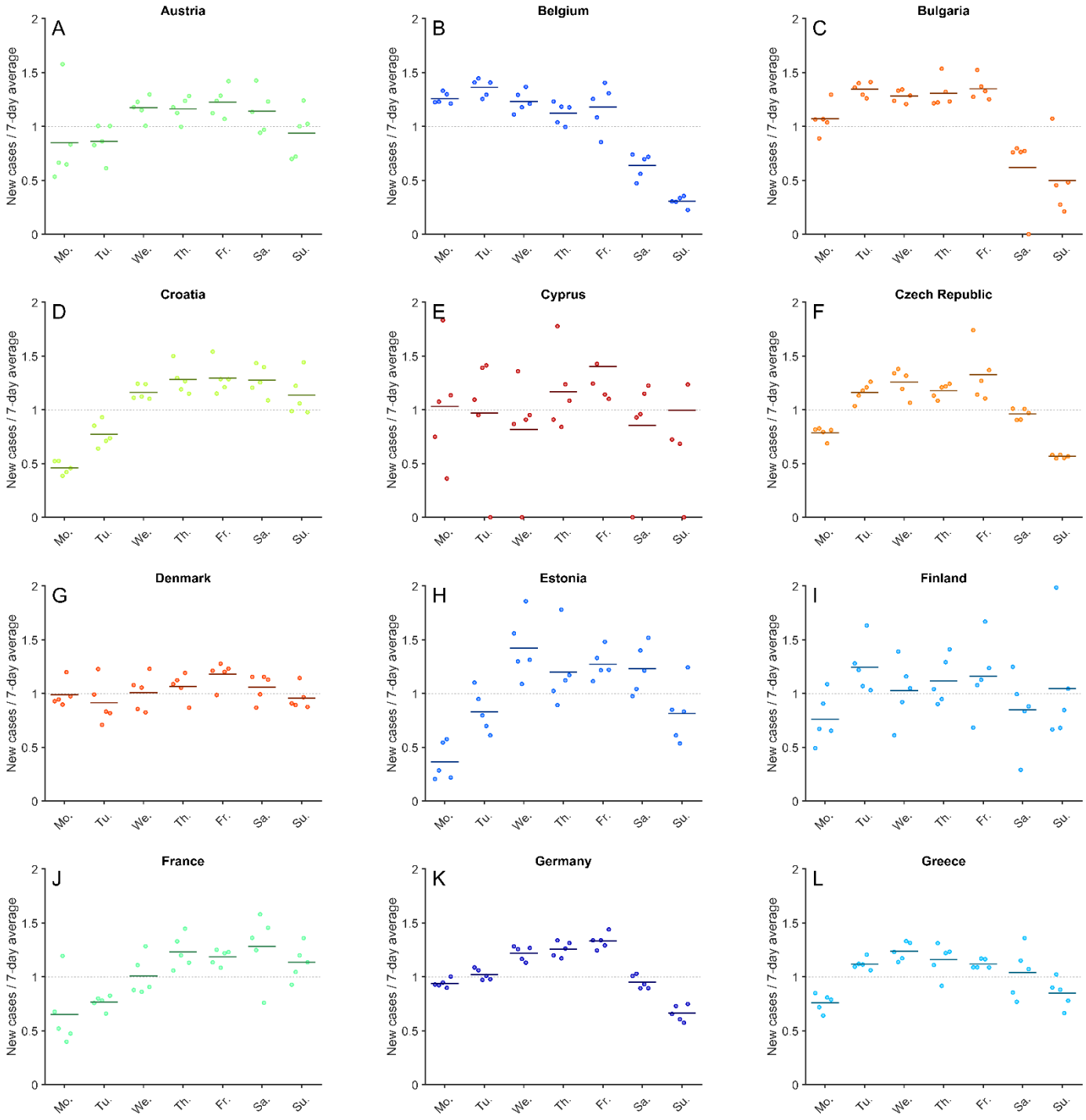
Figure 5. *Box plots of the differences between daily $\rho_7(t)$ values and the average $\bar{\rho}_7$ for each country (Spain, Germany, Italy and EU+EFTA+UK). Differences are due to daily patterns in new cases (weekend effect, Figure 2) and random noise.*

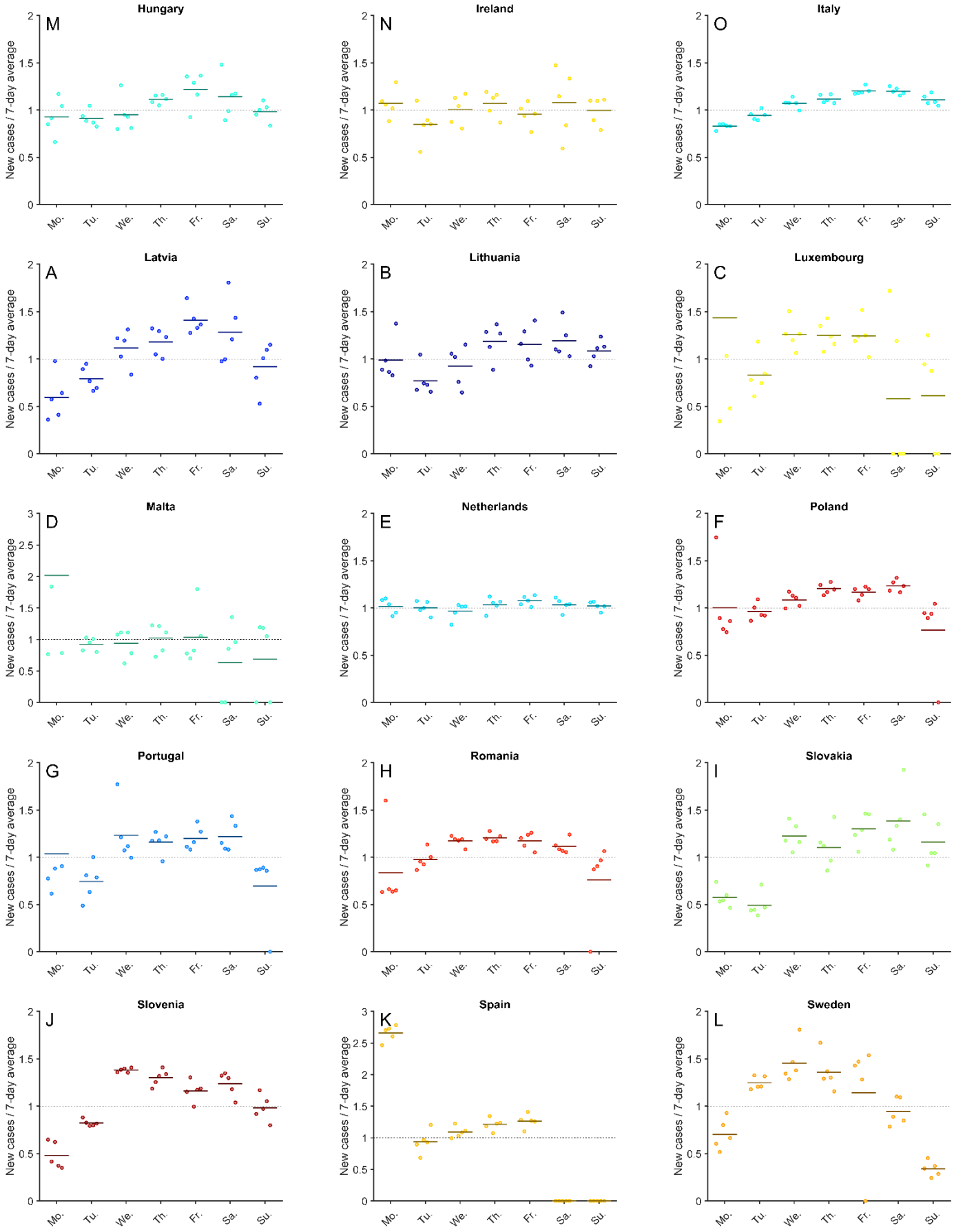
Figure 5 shows, again, that differences are minimal in a constant scenario, while they increase as $\bar{\rho}_7$ moves further from 1. **The steepest the increase or the decrease, the higher the difference between $\boldsymbol{\rho_7(t)}$ and $\boldsymbol{\bar{\rho}_7}$ (i.e., the higher the weekend effect in the reproduction number).** Again, differences increase in countries with highest unbalancing between daily reporting ratios (e.g., Spain).

Conclusions

The discussion above may seem anecdotic, but it is not at all. Most countries base their control decisions on a few indicators, including the daily number of new cases and the reproduction number. In this sense, weekend effect and oscillations in the reproduction number can induce confusion. While weekend effect in daily new cases is widely known, oscillations in the reproduction number may lead to wrong conclusions if they are not well characterized. In next report we will provide a possible solution to correct both effects, beyond the simple 7-day moving average in new cases, using the daily reporting ratios.

Annex: Daily reporting ratios of European countries (last 5 weeks)




Hungary
M
Ireland
N
Italy
O
Latvia
A
Lithuania
B
Luxembourg
C
Malta
D
Netherlands
E
Poland
F
Portugal
G
Romania
H
Slovakia
I
Slovenia
J
Spain
K
Sweden
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New cases / 7-day average
Mo.
Tu.
We.
Th.
Fr.
Sa.
Su.

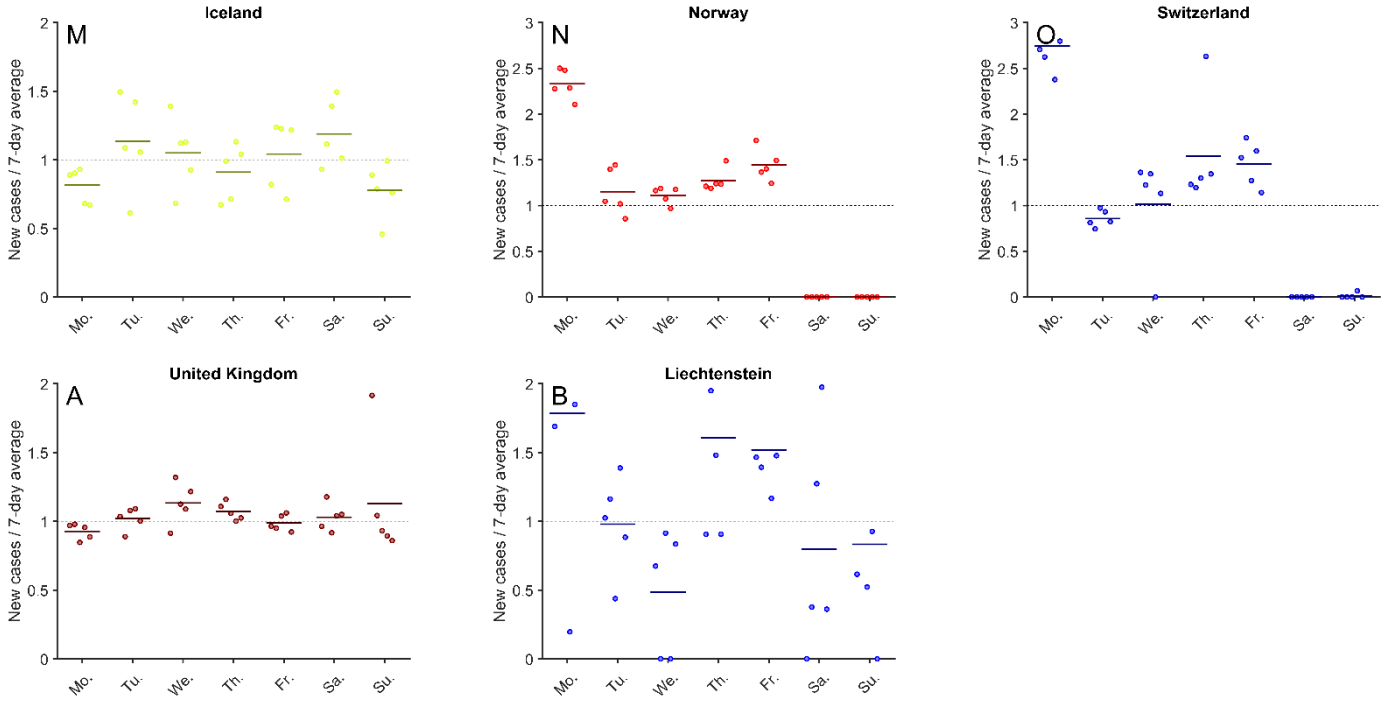
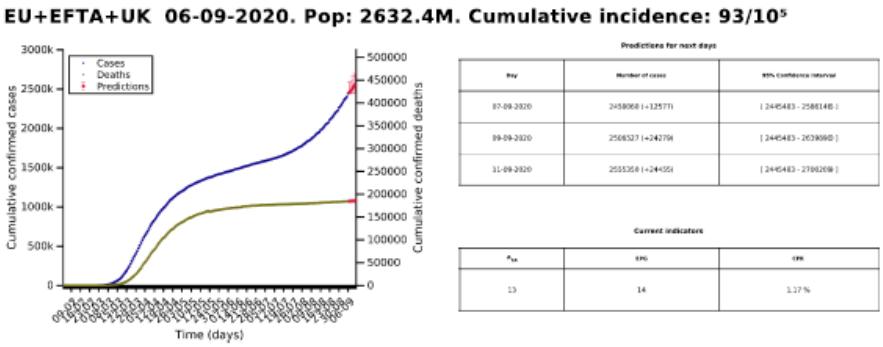


Figure 6. *Reporting ratio between new cases in a certain day, $n(t)$, and the corresponding 7-day moving average value, $n_7(t)$, for each day of the week in European countries. These ratios are evaluated for the last 5 weeks.*

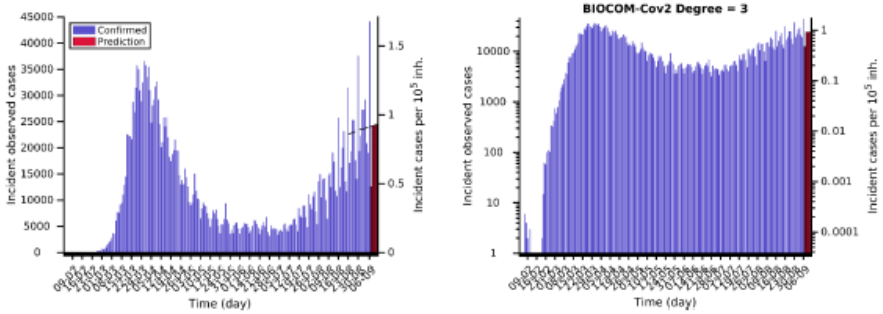
Legend: Countries' reports details

Reported cumulative cases (blue) and deaths (brown), together with predictions (red)



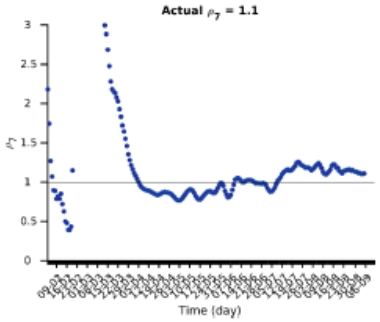
Predictions and indicators

Incident observed cases and predictions.

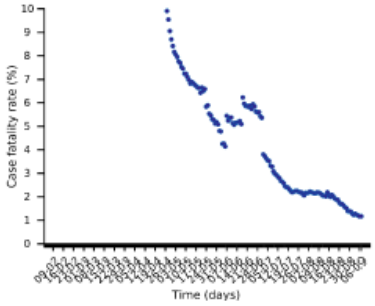


Incident observed cases in a logarithmic scale, with Biocom-Cov degree.

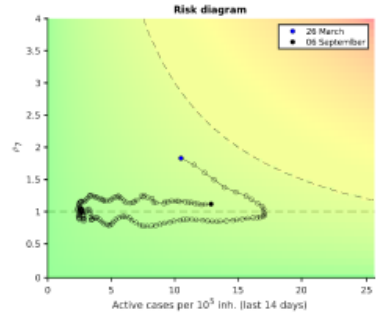
Evolution of empiric reproduction number ρ_7



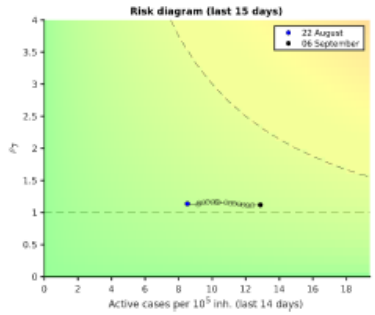
Case fatality rate



Risk diagram

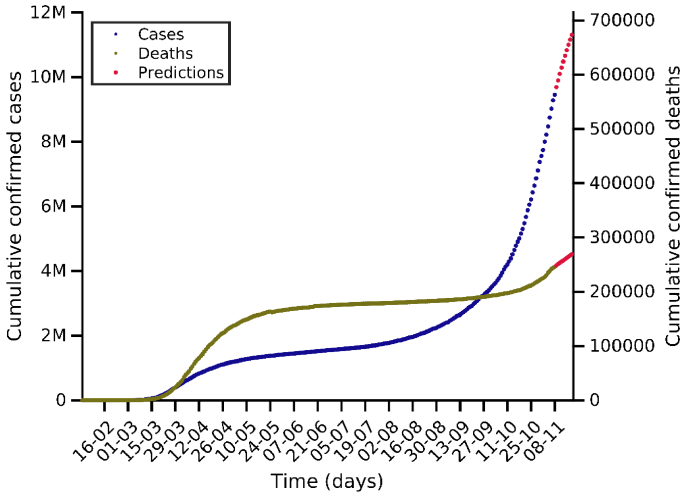


Risk diagram of last 15 days



(1) Analysis and prediction of COVID-19 for EU+EFTA+UK

EU+EFTA+UK 08-11-2020. Pop: 527.9M. Cumulative incidence: 1791/10^5

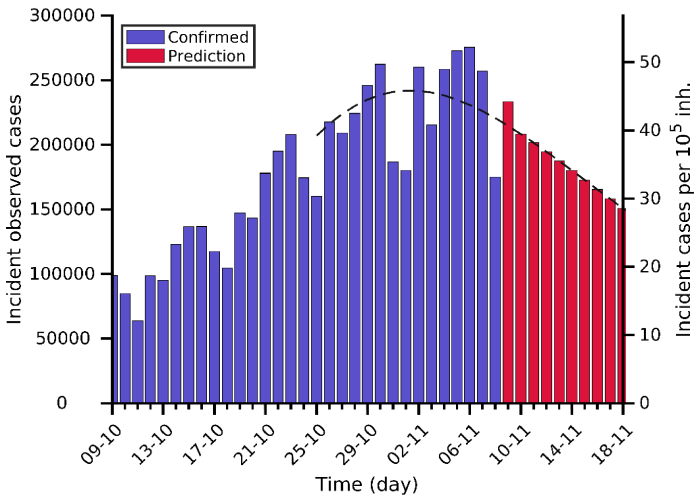


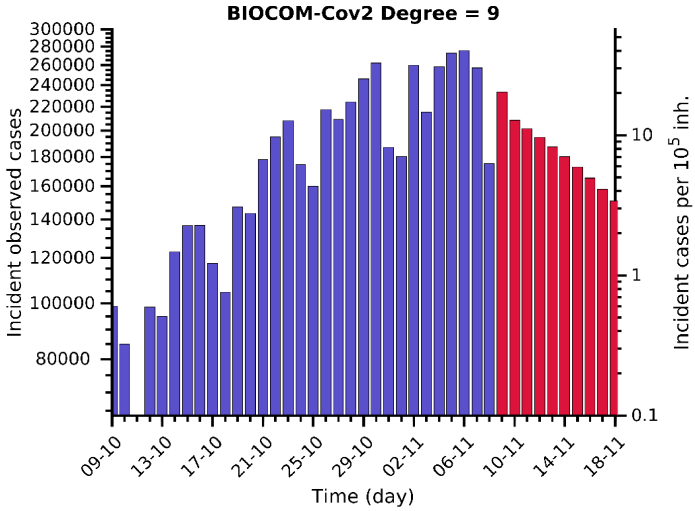
Predictions for next days

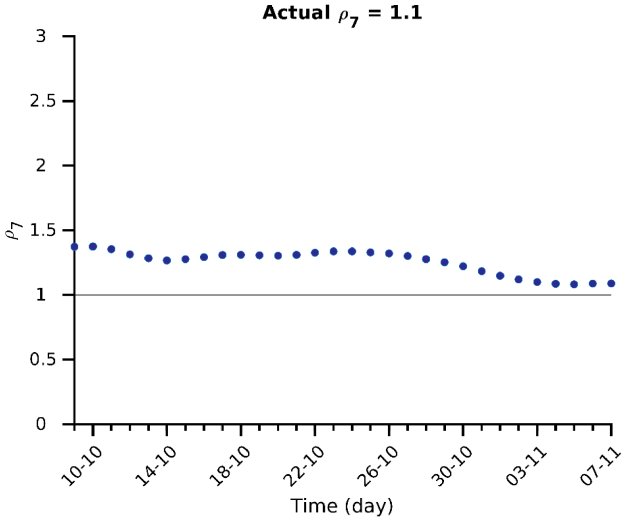
Day	Number of cases	95% Confidence Interval
11-11-2020	10099504 (+643271)	[9718089 - 10480919]
15-11-2020	10834518 (+1378285)	[10199186 - 11469849]
18-11-2020	11308873 (+1852640)	[10326937 - 12290809]

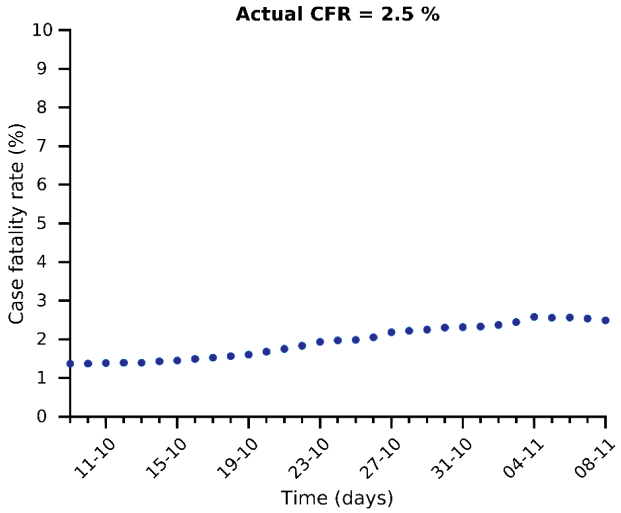
Current indicators

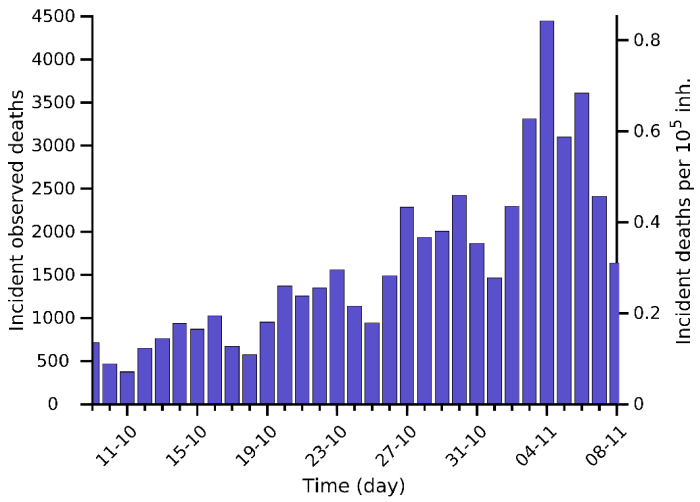
	A14	EPG	CFR	N7	D7
Today	614	668	2.49 %	244892	2974
A Week ago	518	612	2.33 %	218014	1925
Maximum	614	668	5.00 %	245616	4271

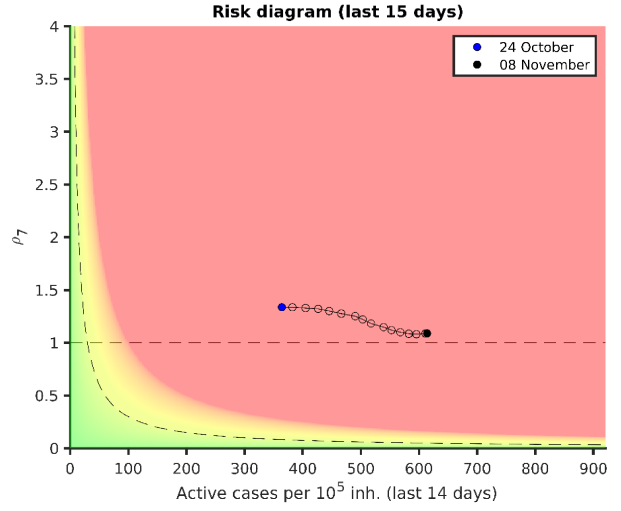




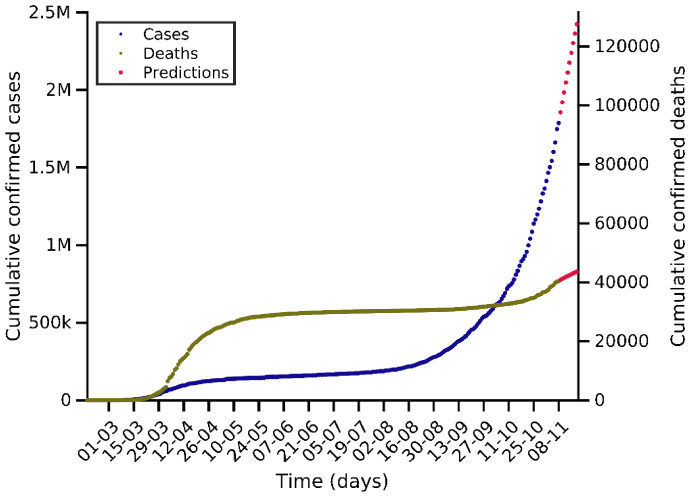








France 08-11-2020. Pop: 65.3M. Cumulative incidence: $2738/10^5$

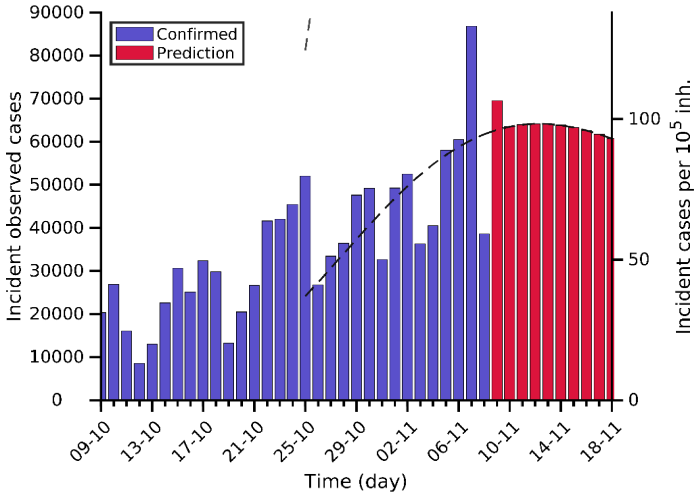


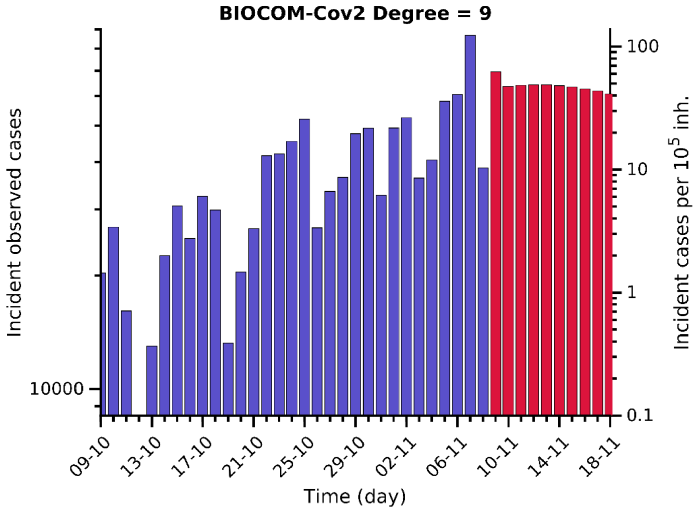
Predictions for next days

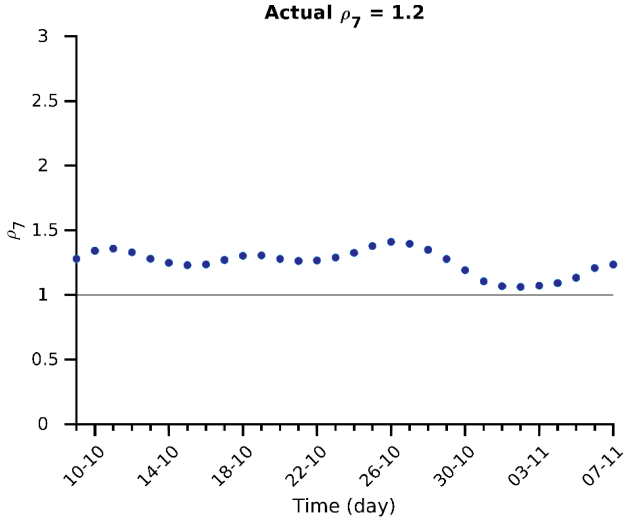
Day	Number of cases	95% Confidence Interval
11-11-2020	1984350 (+197026)	[1787324 - 2201649]
15-11-2020	2239857 (+452533)	[1787324 - 2711258]
18-11-2020	2424948 (+637624)	[1787324 - 3264981]

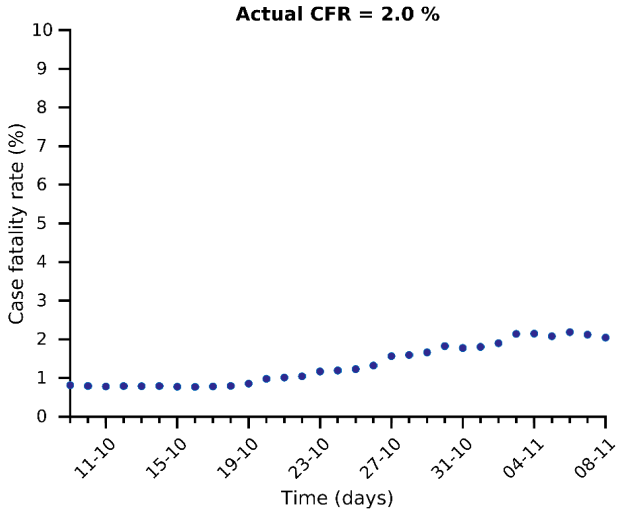
Current indicators

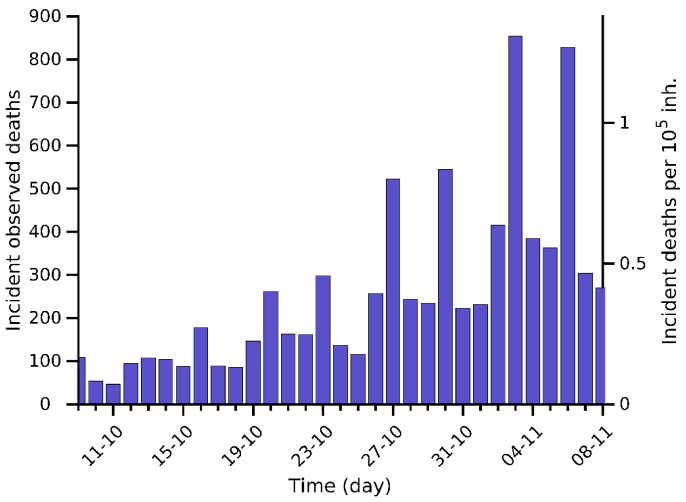
	A14	EPG	CFR	N7	D7
Today	994	1227	2.04 %	53344	489
A Week ago	792	875	1.80 %	39344	323
Maximum	1015	1227	4.94 %	54869	1101

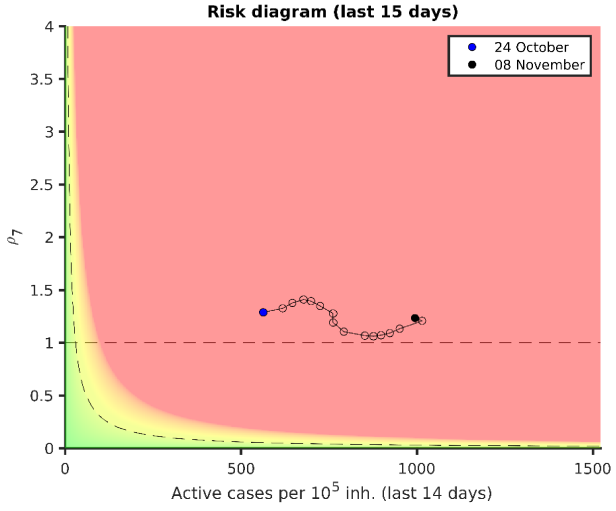




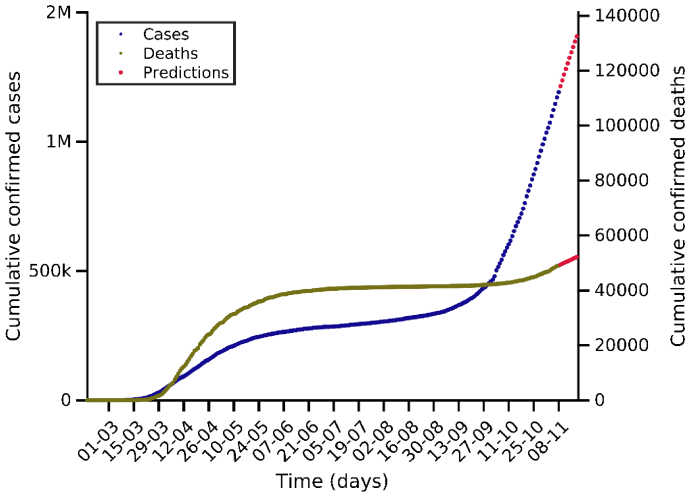








UK 08-11-2020. Pop: 67.9M. Cumulative incidence: 1756/10⁵

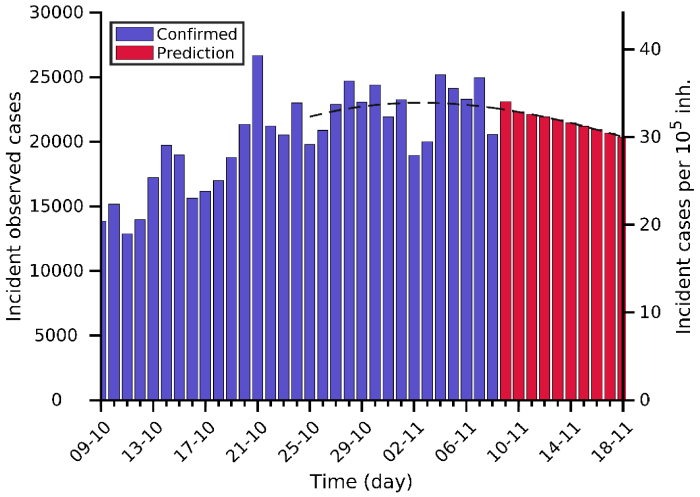


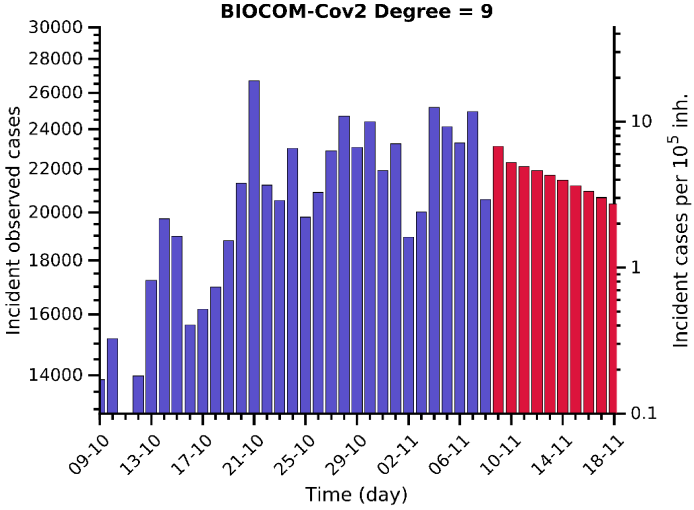
Predictions for next days

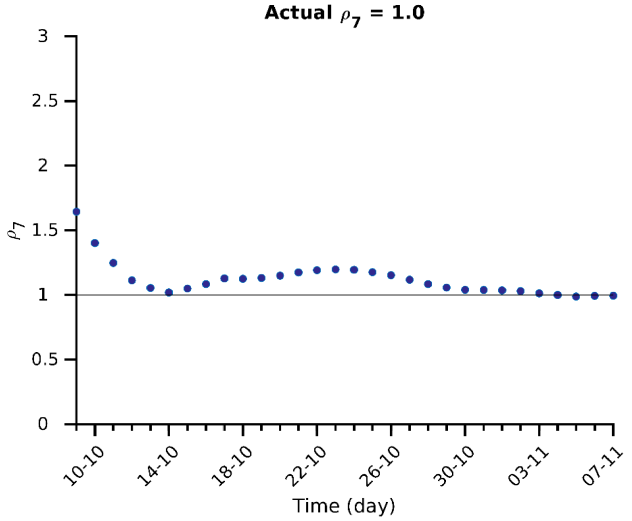
Day	Number of cases	95% Confidence Interval
11-11-2020	1259556 (+67543)	[1240185 - 1278927]
15-11-2020	1345834 (+153821)	[1307406 - 1384263]
18-11-2020	1407808 (+215795)	[1340283 - 1475334]

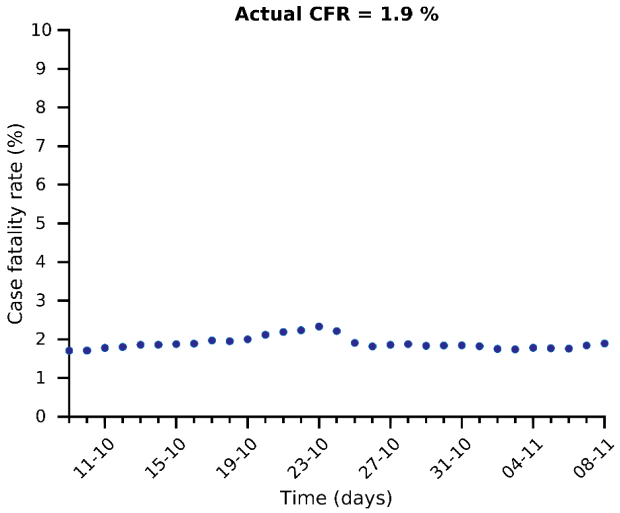
Current indicators

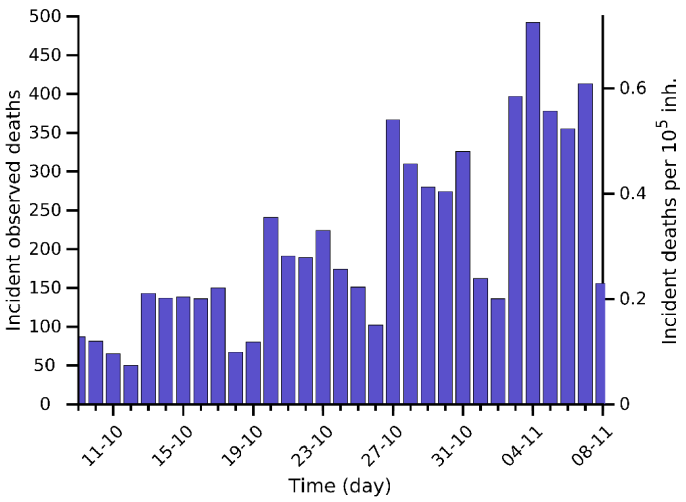
	A14	EPG	CFR	N7	D7
Today	469	466	1.89 %	22443	332
A Week ago	460	478	1.82 %	23016	260
Maximum	469	480	4.95 %	23016	942

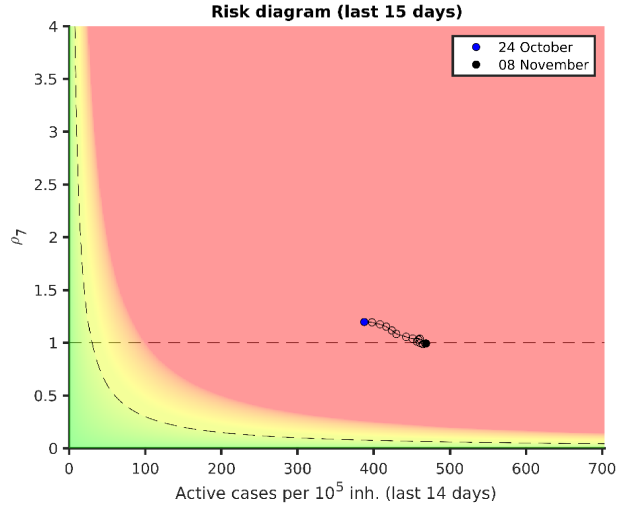




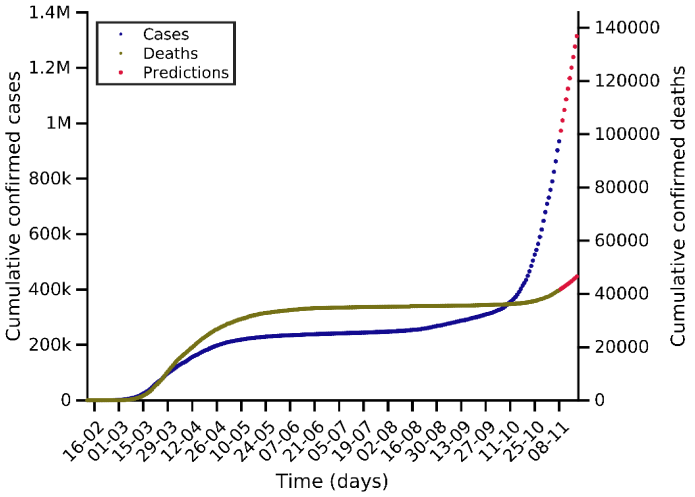








Italy 08-11-2020. Pop: 60.5M. Cumulative incidence: 1547/10^5

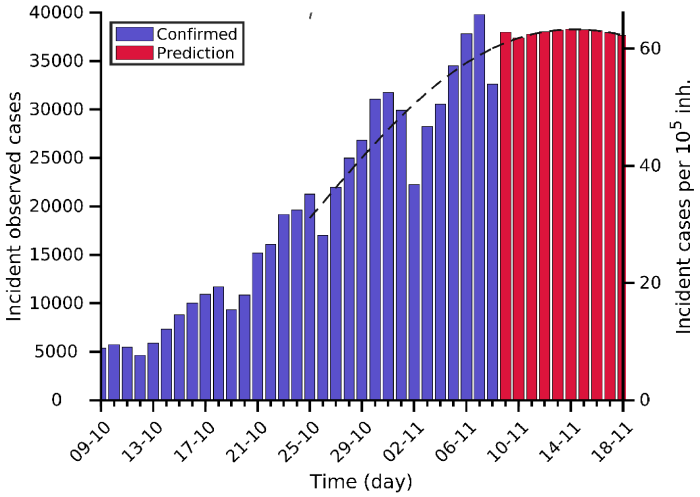


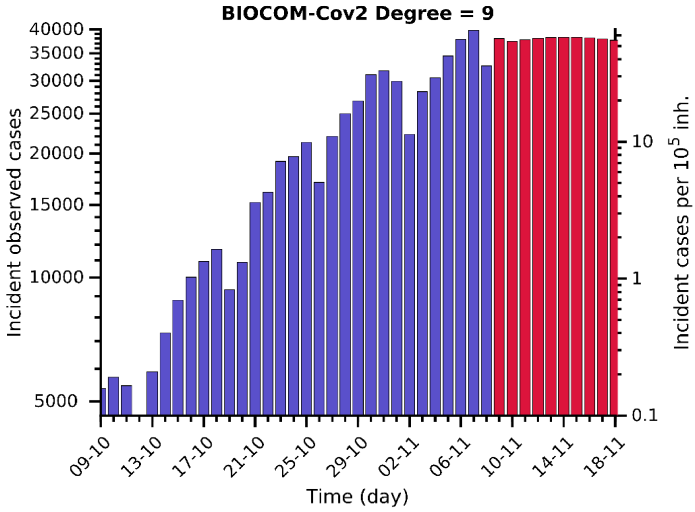
Predictions for next days

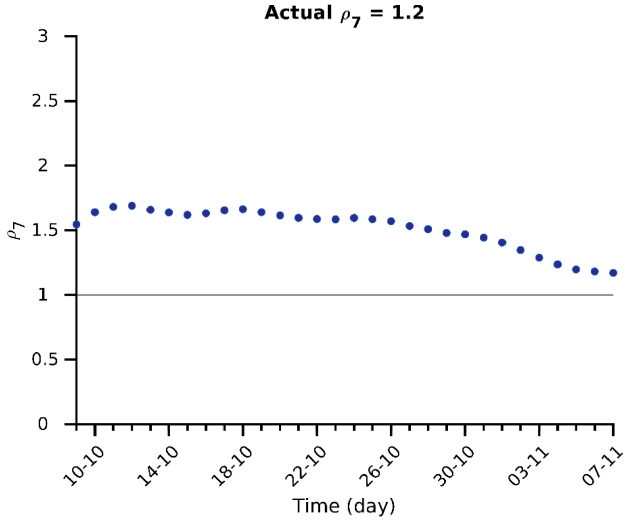
Day	Number of cases	95% Confidence Interval
11-11-2020	1048202 (+113098)	[1010454 - 1085950]
15-11-2020	1200926 (+265822)	[1117688 - 1284164]
18-11-2020	1314660 (+379556)	[1162676 - 1466644]

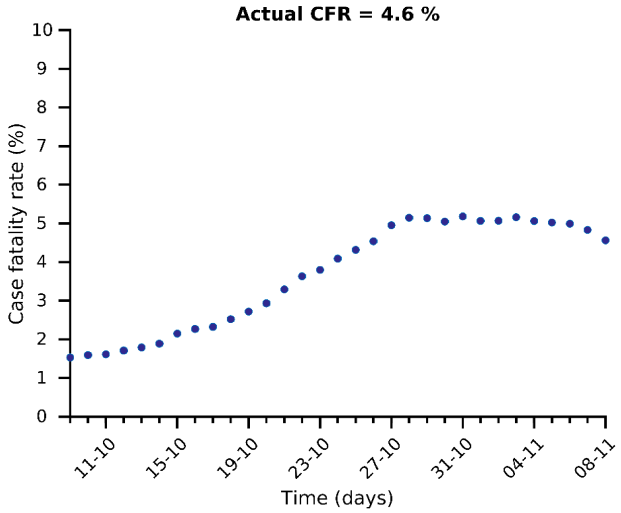
Current indicators

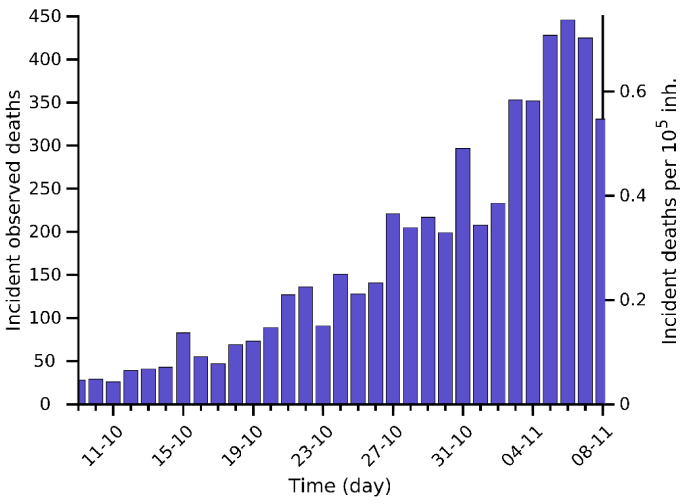
	A14	EPG	CFR	N7	D7
Today	677	792	4.56 %	32253	367
A Week ago	488	705	5.06 %	26222	213
Maximum	677	792	4.99 %	32253	822

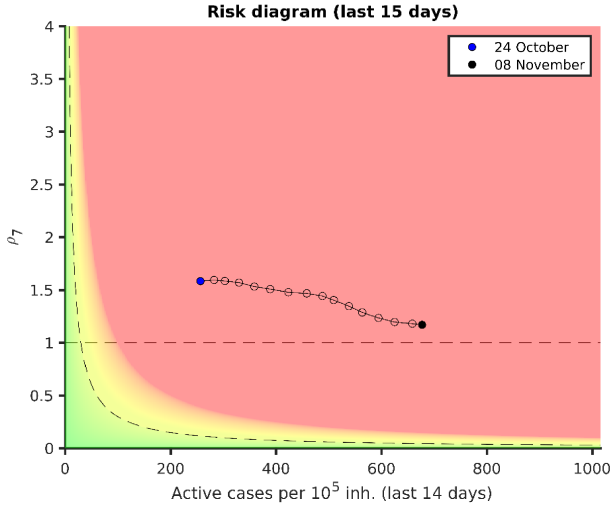




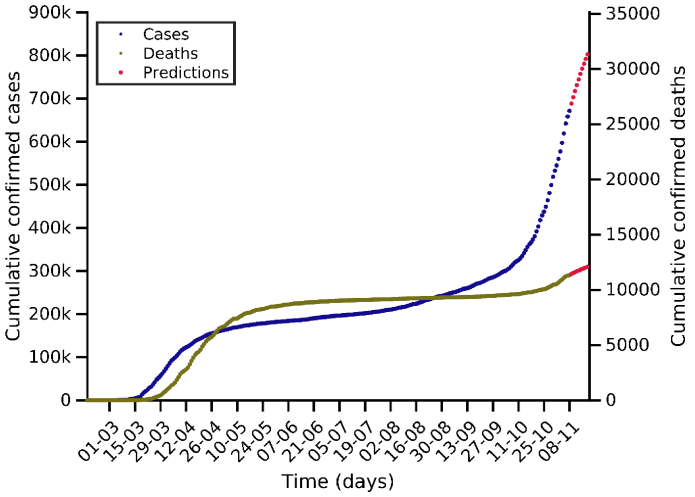








Germany 08-11-2020. Pop: 83.8M. Cumulative incidence: 802/10⁵

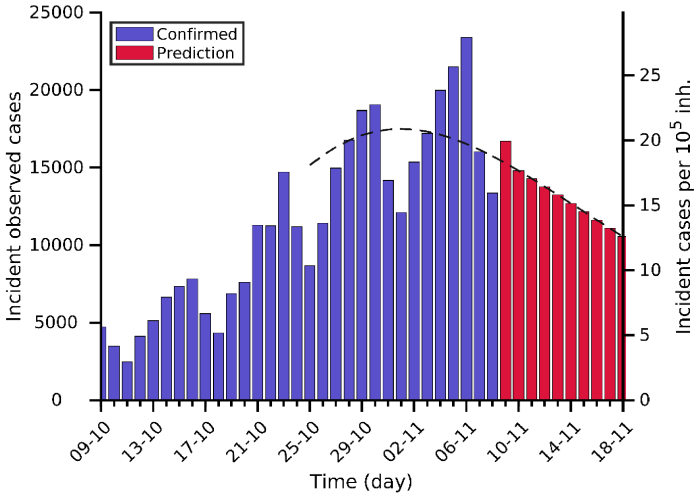


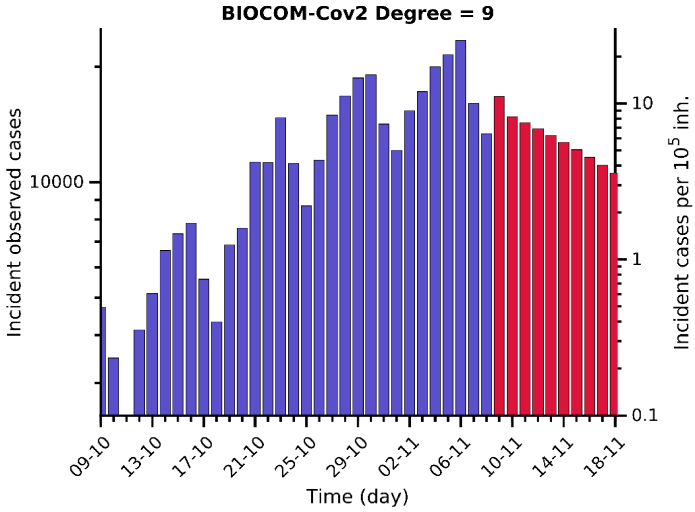
Predictions for next days

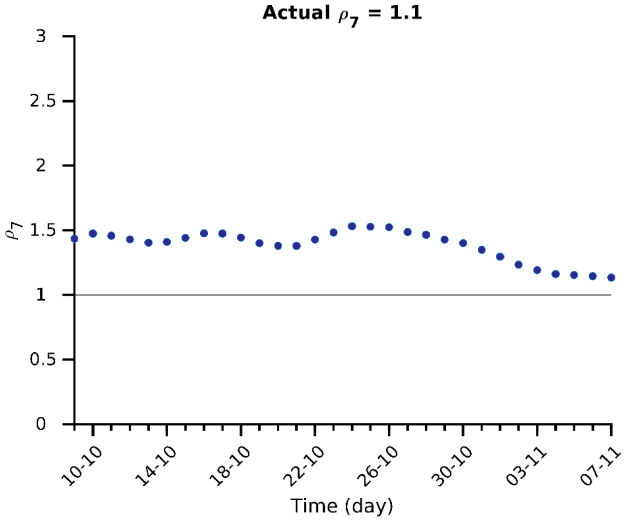
Day	Number of cases	95% Confidence Interval
11-11-2020	717685 (+45817)	[683988 - 751382]
15-11-2020	769557 (+97689)	[714067 - 825046]
18-11-2020	802806 (+130938)	[717725 - 887886]

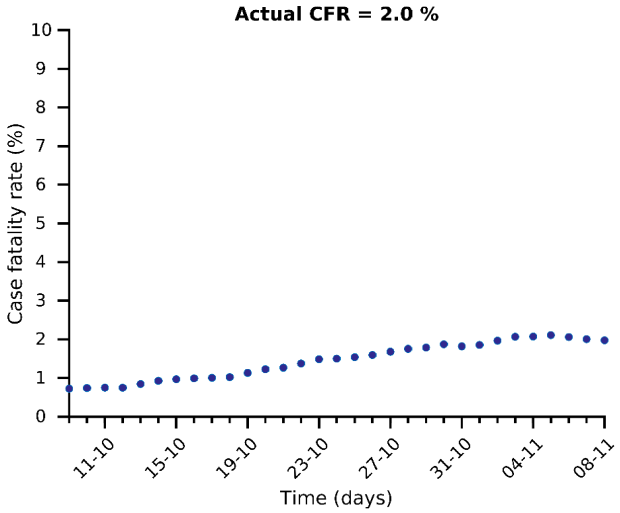
Current indicators

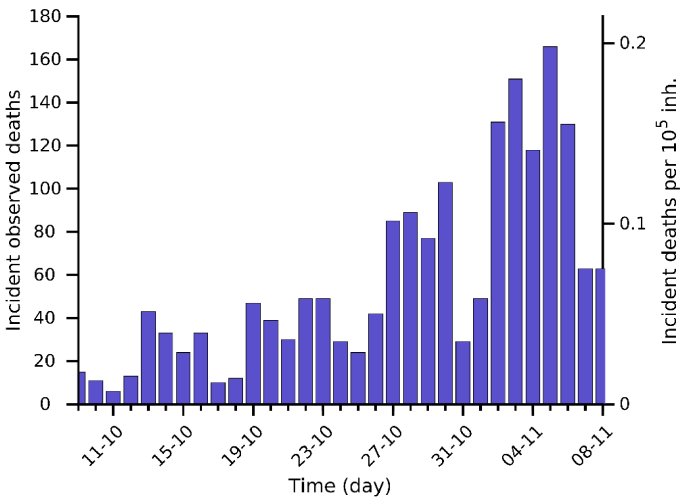
	A14	EPG	CFR	N7	D7
Today	279	317	1.97 %	18120	117
A Week ago	213	288	1.85 %	15309	68
Maximum	279	317	4.57 %	18120	233

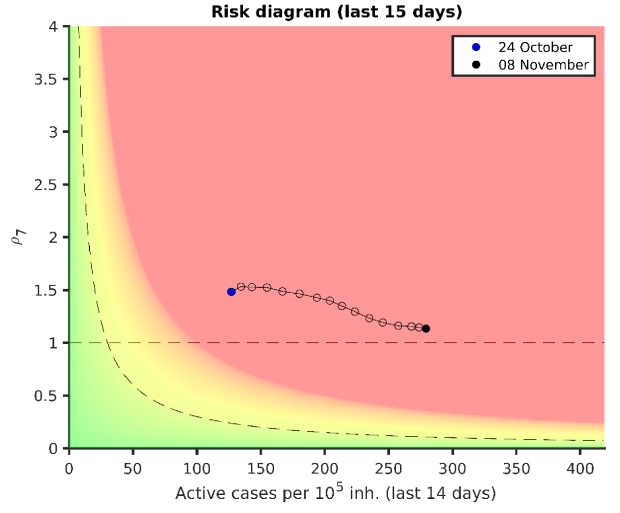




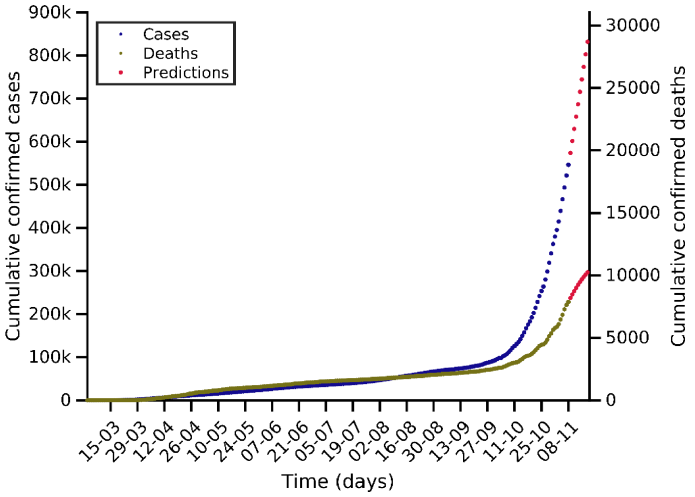








Poland 08-11-2020. Pop: 37.8M. Cumulative incidence: $1444/10^5$

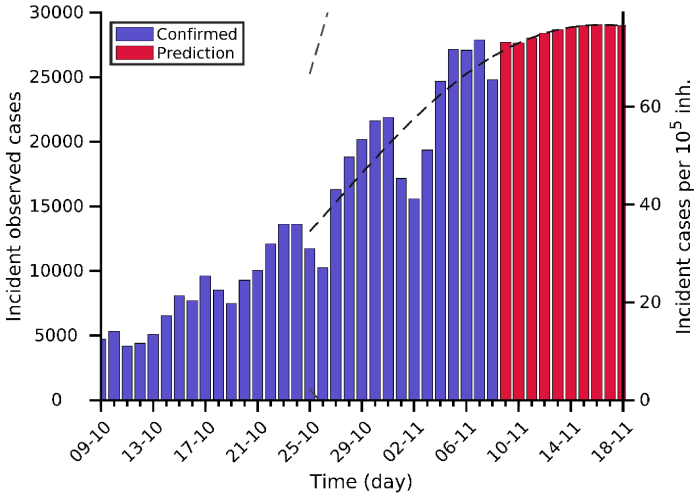


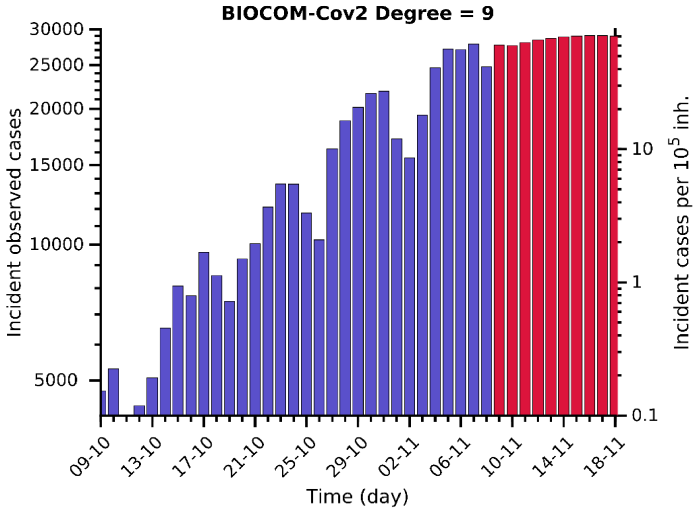
Predictions for next days

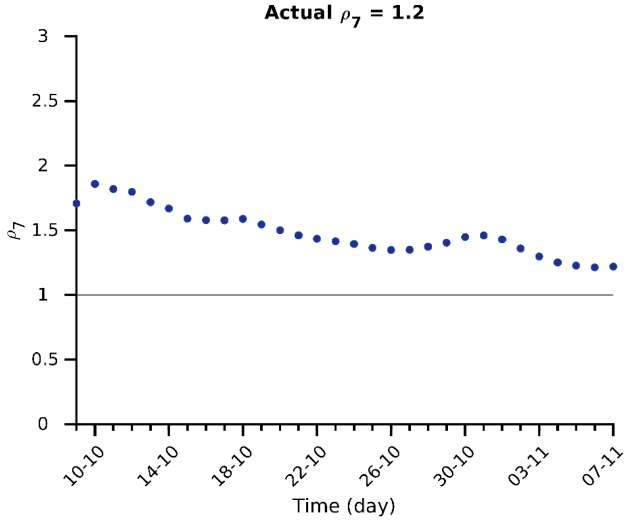
Day	Number of cases	95% Confidence Interval
11-11-2020	629828 (+83403)	[608120 - 651536]
15-11-2020	744746 (+198321)	[695134 - 794359]
18-11-2020	831833 (+285408)	[739478 - 924189]

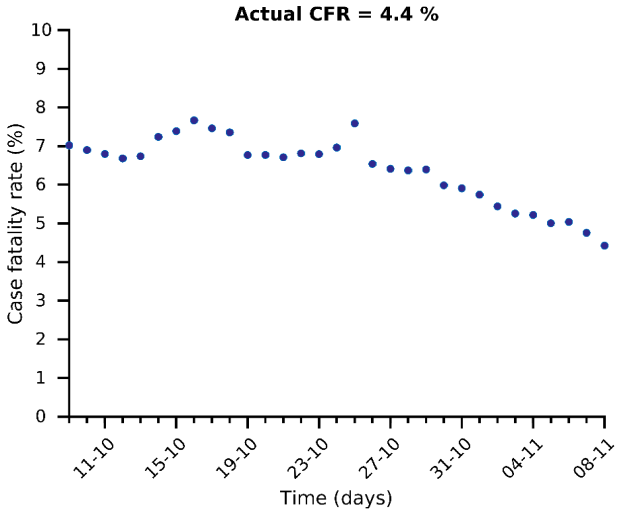
Current indicators

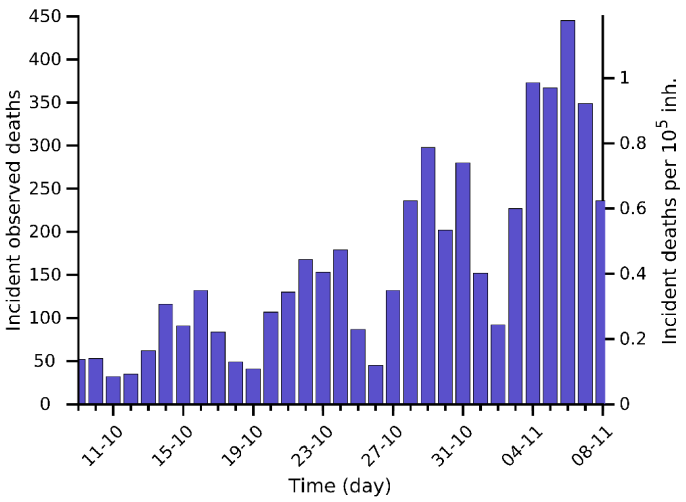
	A14	EPG	CFR	N7	D7
Today	773	943	4.42 %	23789	298
A Week ago	539	787	5.74 %	18031	192
Maximum	773	943	5.00 %	23789	298

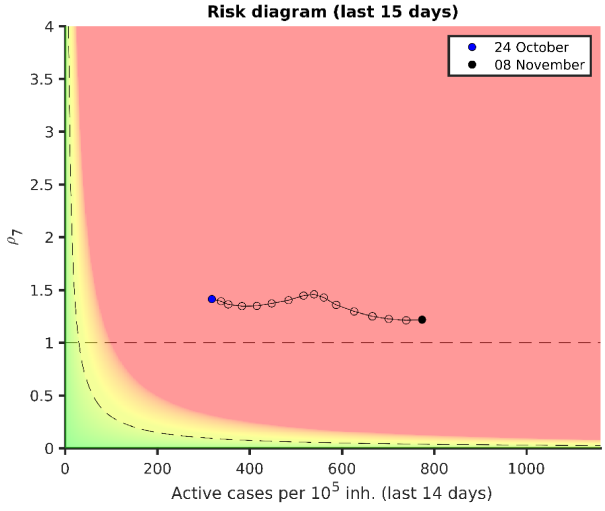




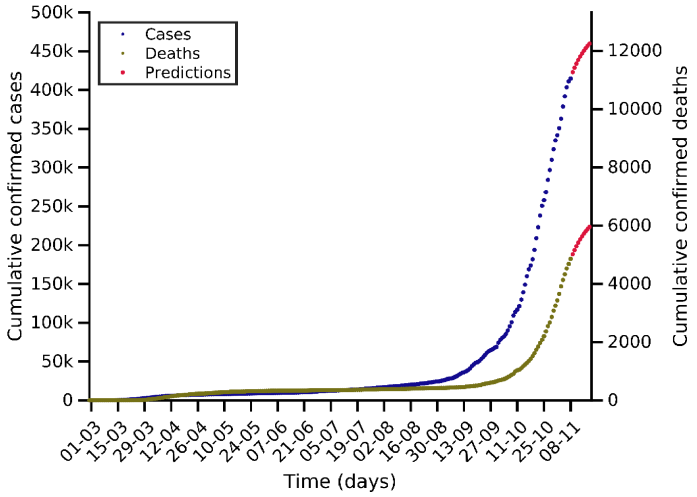








Czech Rep 08-11-2020. Pop: 10.7M. Cumulative incidence: 3874/10⁵

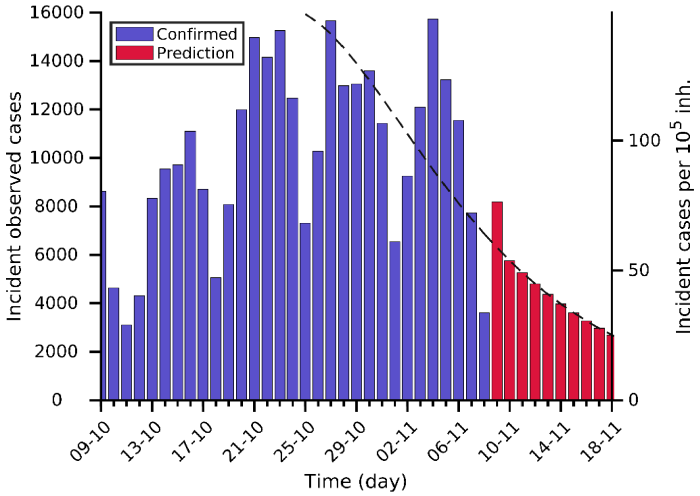


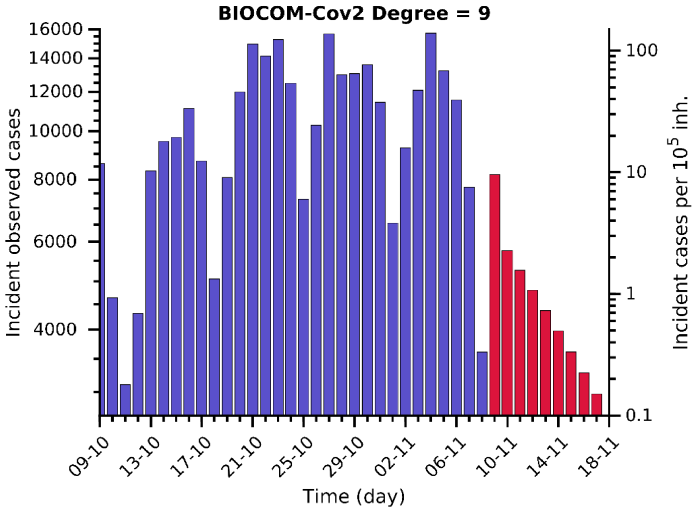
Predictions for next days

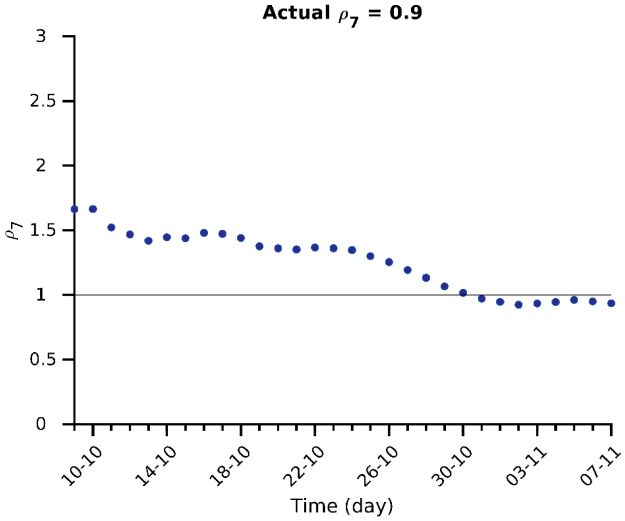
Day	Number of cases	95% Confidence Interval
11-11-2020	434042 (+19214)	[414828 - 471029]
15-11-2020	450796 (+35968)	[414828 - 498230]
18-11-2020	459733 (+44905)	[414828 - 519221]

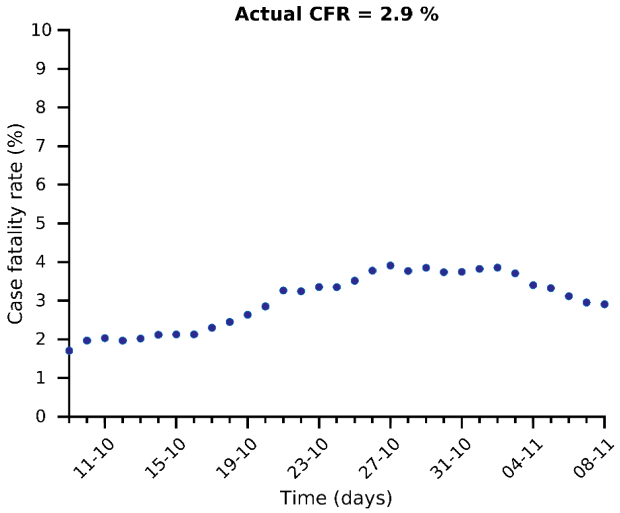
Current indicators

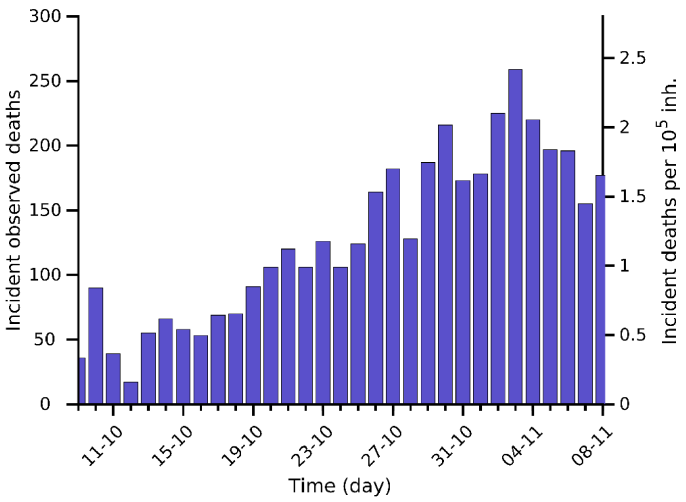
	A14	EPG	CFR	N7	D7
Today	1464	1369	2.91 %	10455	204
A Week ago	1567	1521	3.82 %	11935	175
Maximum	1586	1807	4.98 %	12870	210

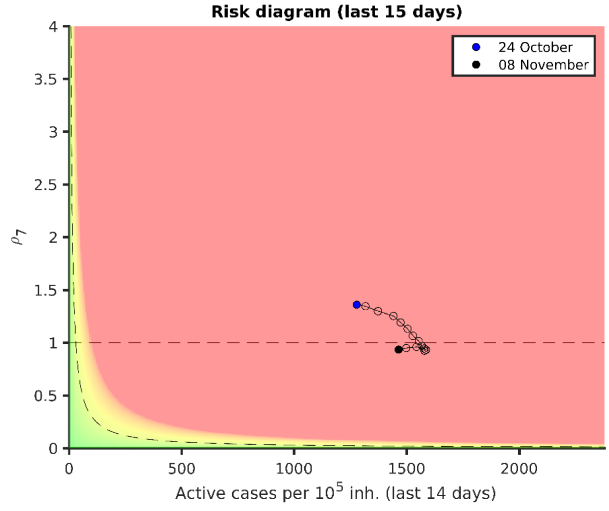




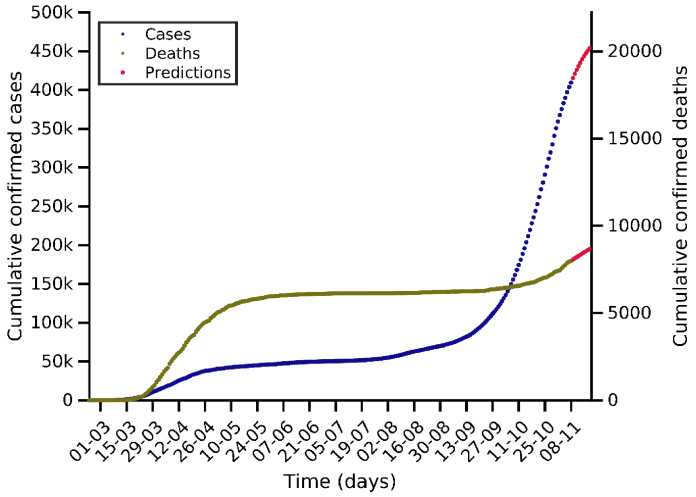








Netherlands 08-11-2020. Pop: 17.1M. Cumulative incidence: 2390/10⁵

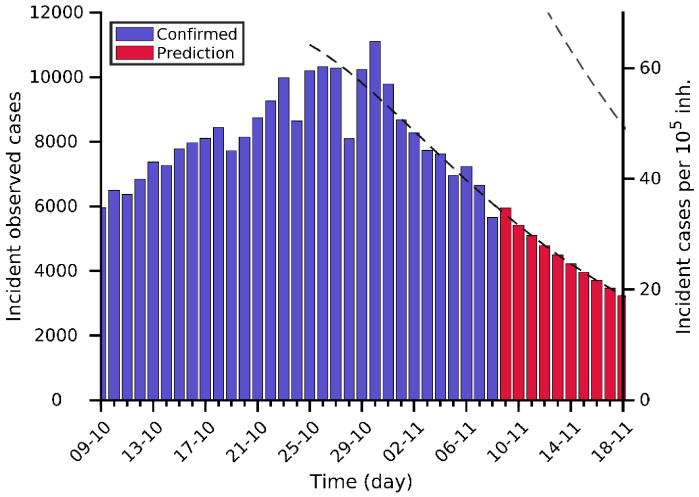


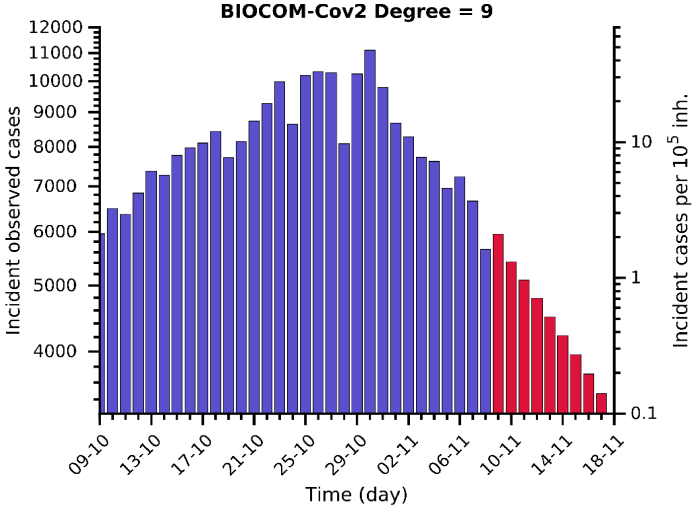
Predictions for next days

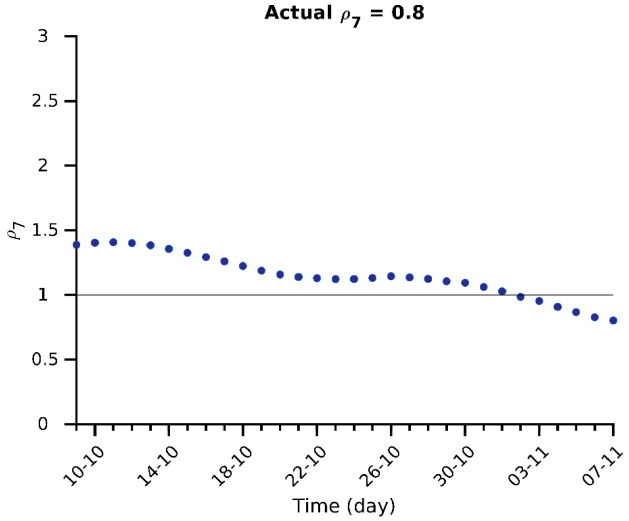
Day	Number of cases	95% Confidence Interval
11-11-2020	426038 (+16465)	[421422 - 430653]
15-11-2020	443506 (+33933)	[436813 - 450198]
18-11-2020	453917 (+44344)	[444520 - 463315]

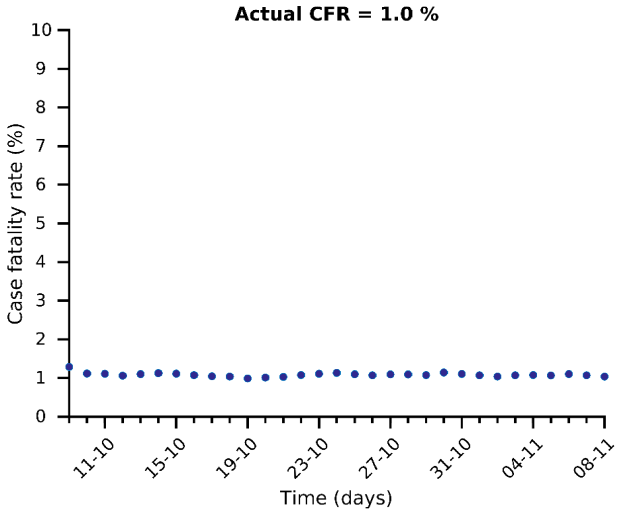
Current indicators

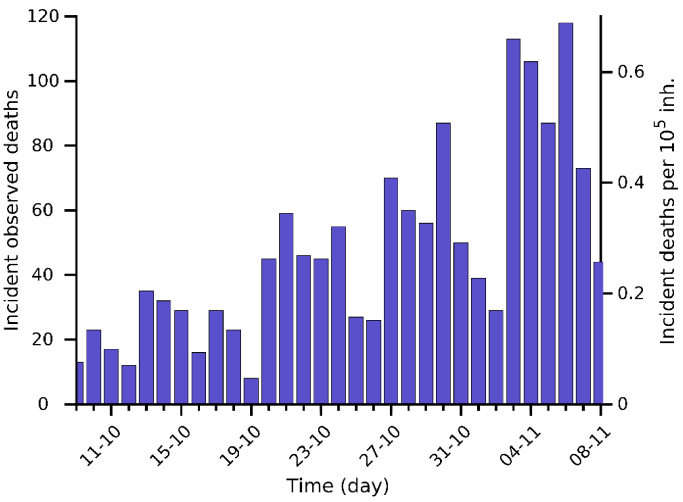
	A14	EPG	CFR	N7	D7
Today	692	556	1.04 %	7162	81
A Week ago	766	813	1.07 %	9787	55
Maximum	769	836	4.98 %	10005	154

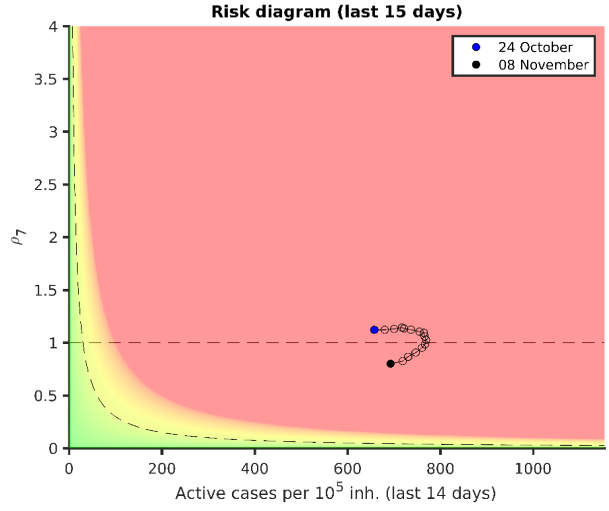




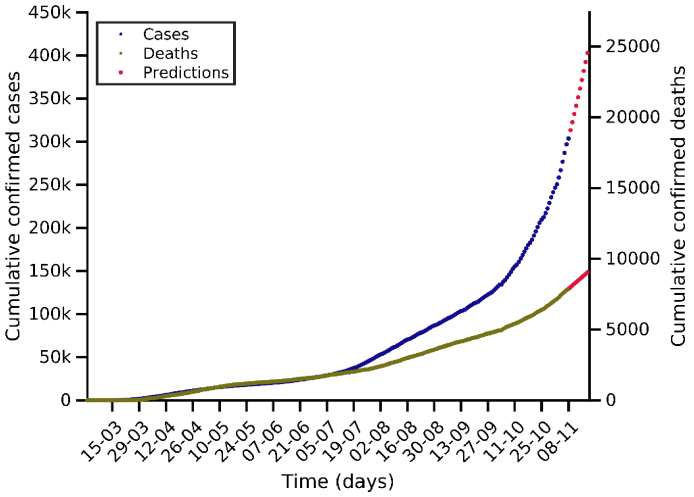








Romania 08-11-2020. Pop: 19.2M. Cumulative incidence: 1579/10^5

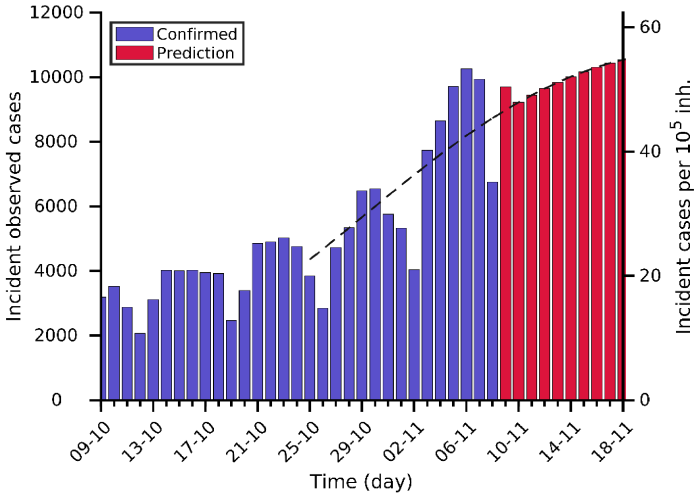


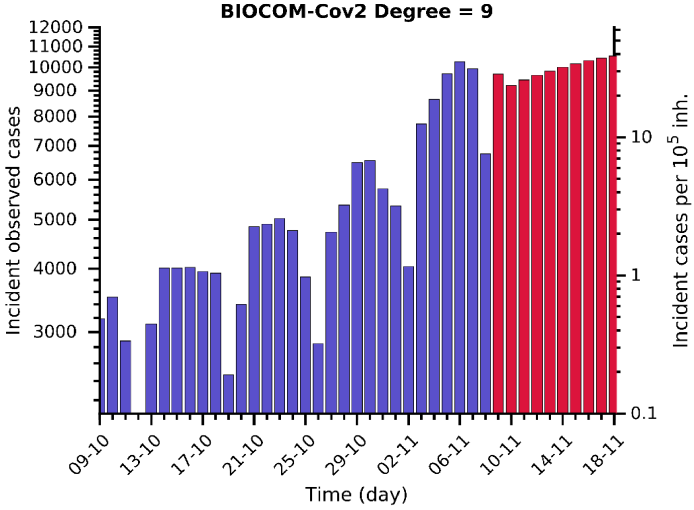
Predictions for next days

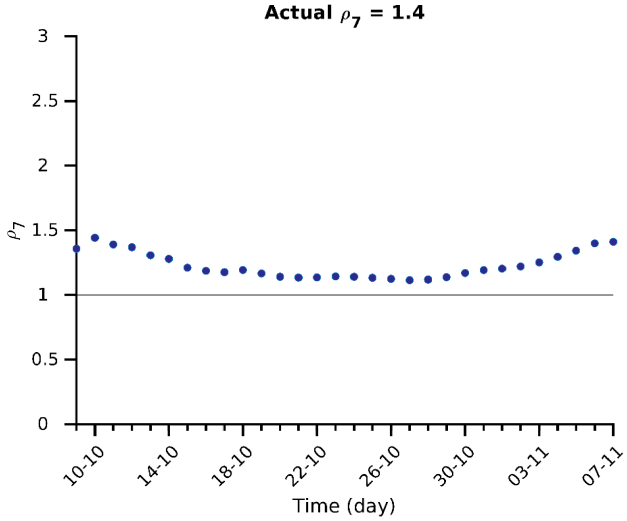
Day	Number of cases	95% Confidence Interval
11-11-2020	332114 (+28363)	[313070 - 351158]
15-11-2020	371782 (+68031)	[325081 - 418483]
18-11-2020	403068 (+99317)	[312256 - 493879]

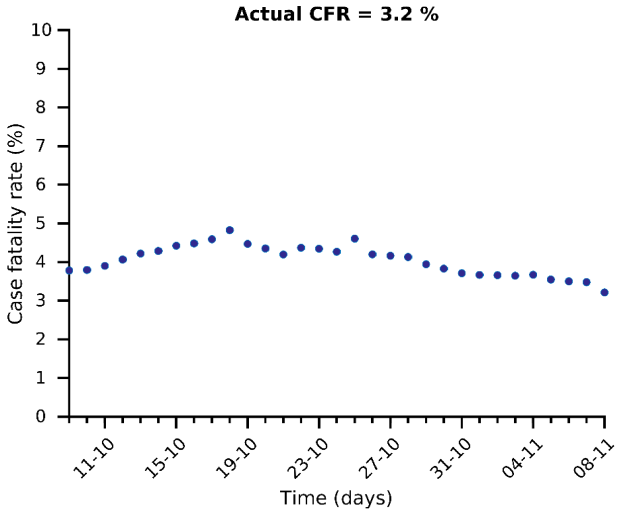
Current indicators

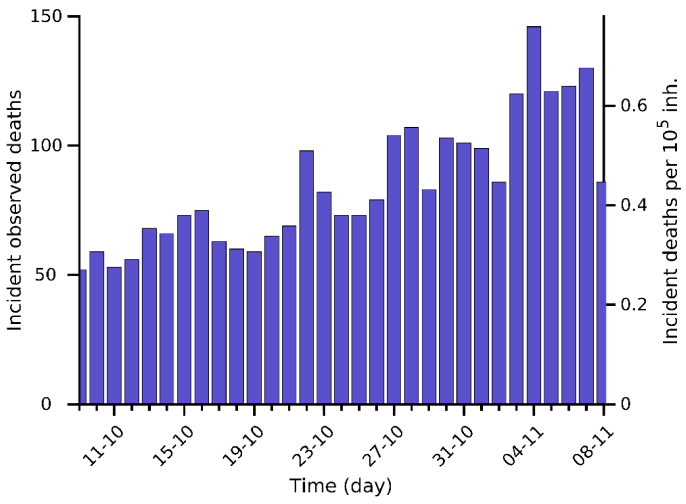
	A14	EPG	CFR	N7	D7
Today	489	690	3.21 %	8155	116
A Week ago	345	411	3.66 %	5288	97
Maximum	489	690	4.96 %	8155	118

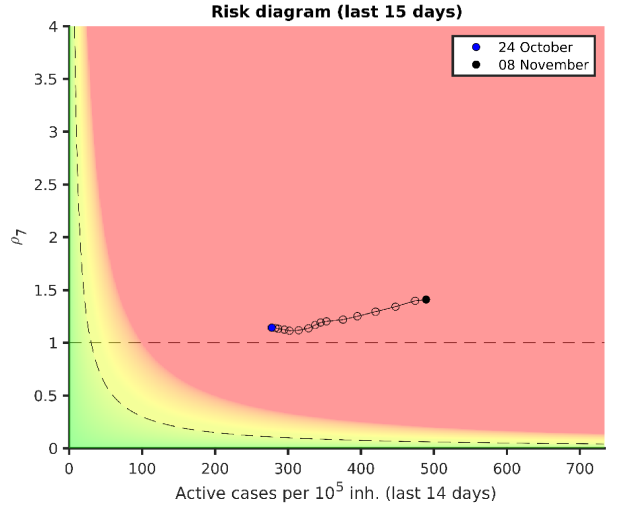




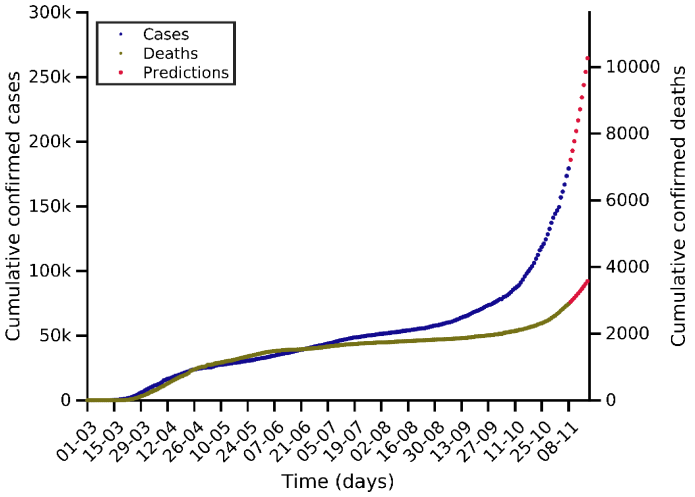








Portugal 08-11-2020. Pop: 10.2M. Cumulative incidence: 1759/10⁵

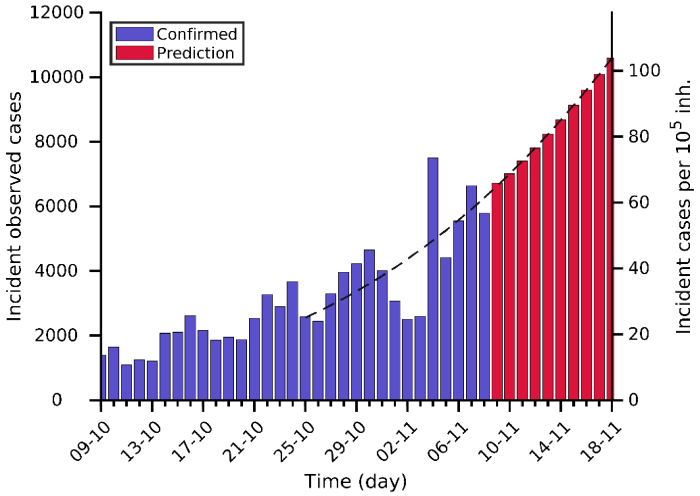


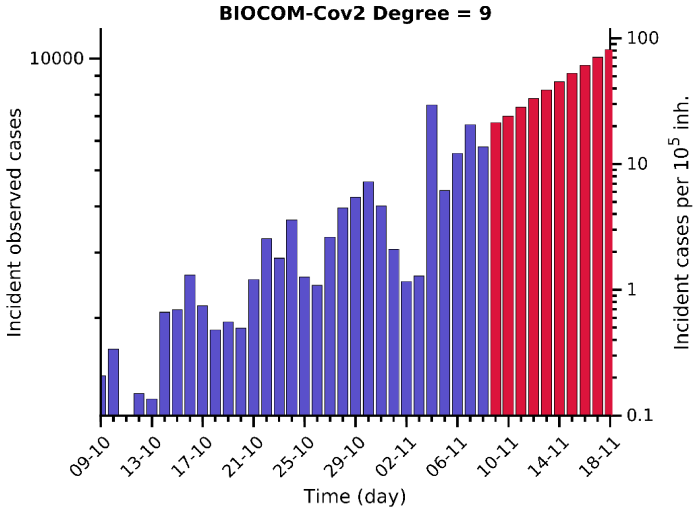
Predictions for next days

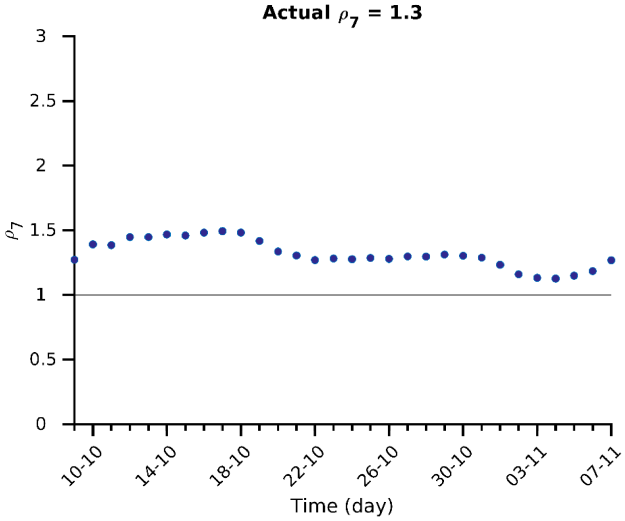
Day	Number of cases	95% Confidence Interval
11-11-2020	200449 (+21125)	[191922 - 208976]
15-11-2020	234299 (+54975)	[207201 - 261397]
18-11-2020	264577 (+85253)	[204048 - 325106]

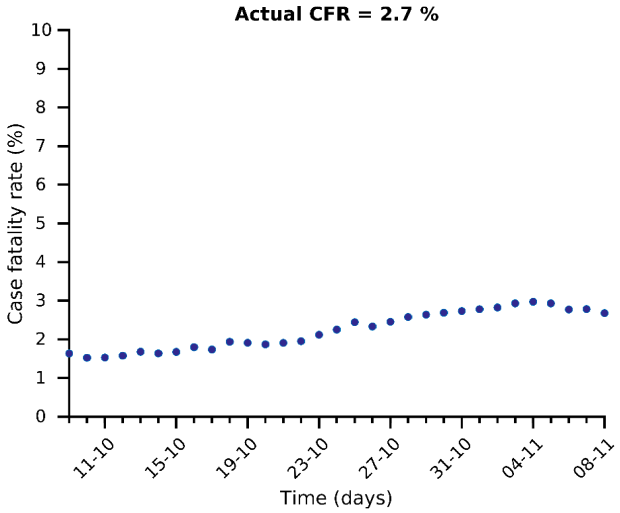
Current indicators

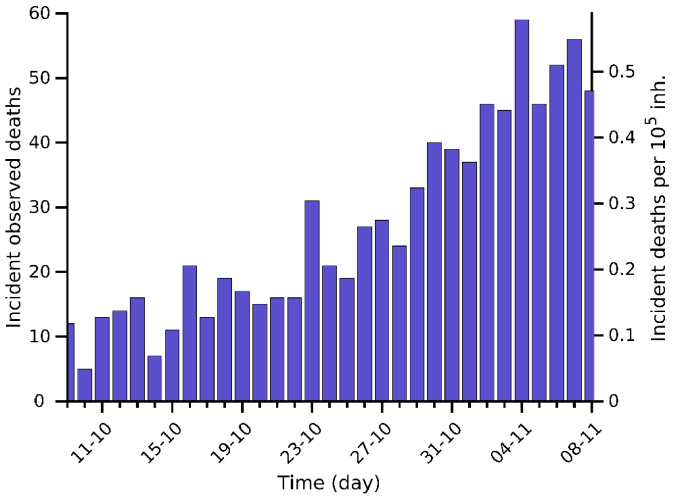
	A14	EPG	CFR	N7	D7
Today	595	754	2.68 %	4998	50
A Week ago	436	561	2.78 %	3665	33
Maximum	595	754	4.98 %	4998	50

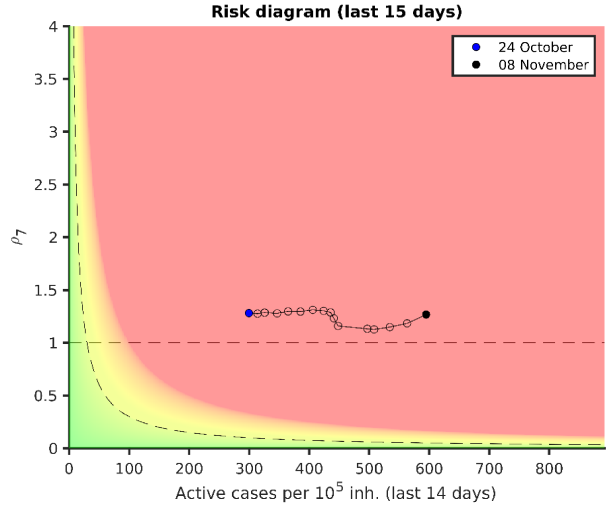




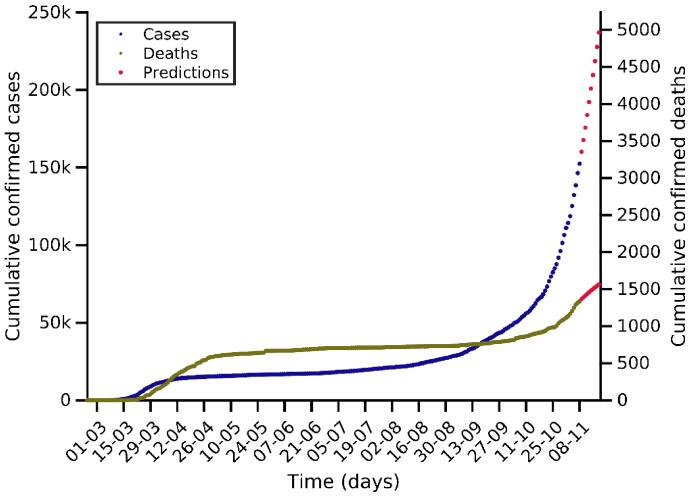








Austria 08-11-2020. Pop: 9.0M. Cumulative incidence: 1693/10^5

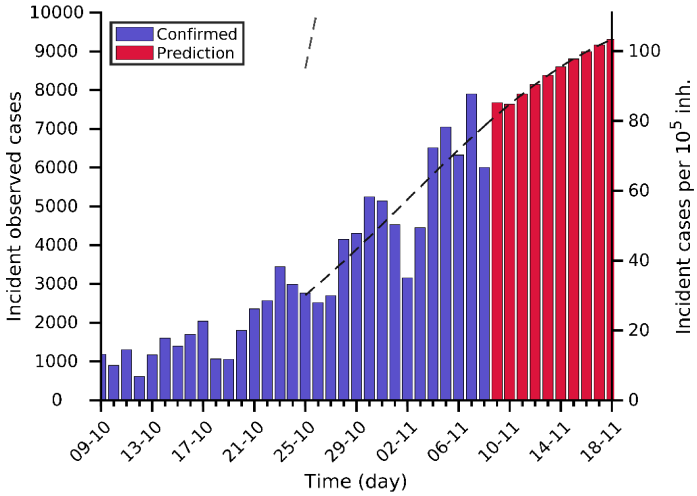


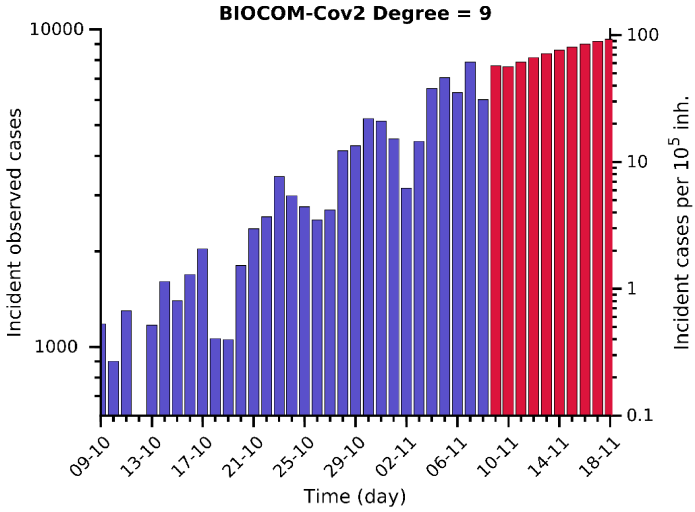
Predictions for next days

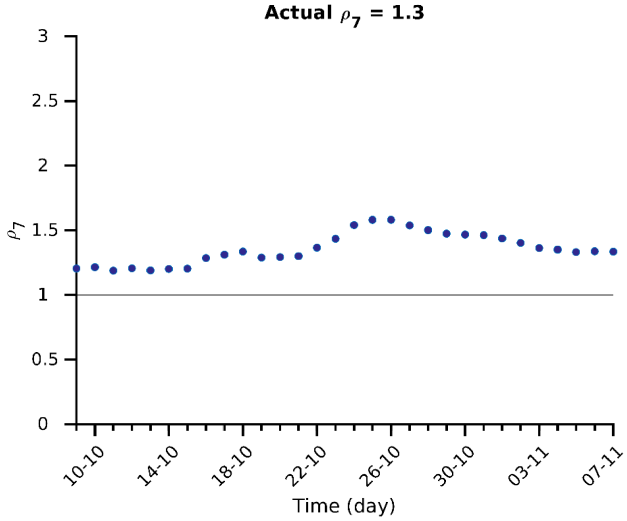
Day	Number of cases	95% Confidence Interval
11-11-2020	175718 (+23210)	[165247 - 186189]
15-11-2020	209656 (+57148)	[182038 - 237274]
18-11-2020	237118 (+84610)	[181924 - 292313]

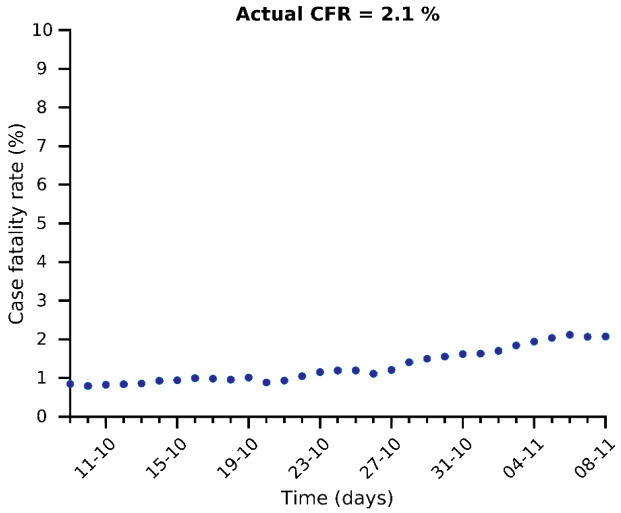
Current indicators

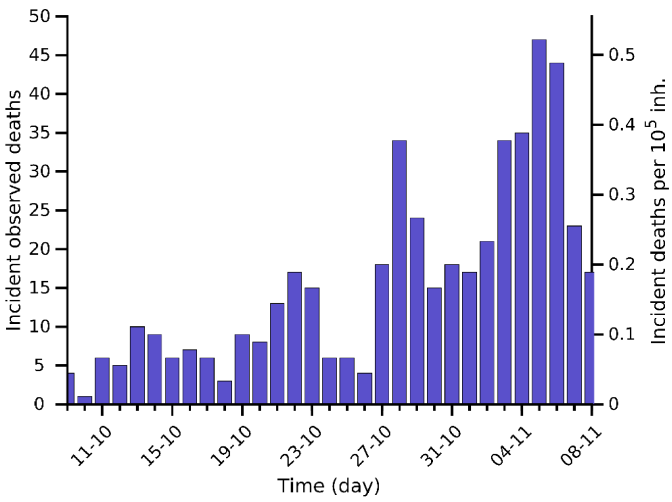
	A14	EPG	CFR	N7	D7
Today	777	1037	2.07 %	5914	32
A Week ago	506	740	1.63 %	4082	19
Maximum	777	1037	4.93 %	5914	32

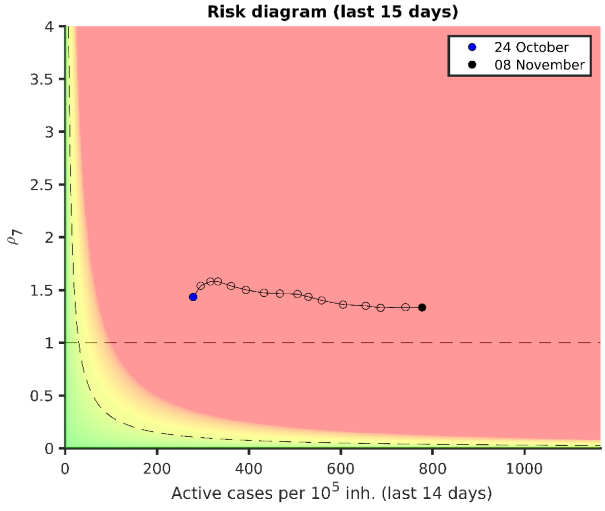




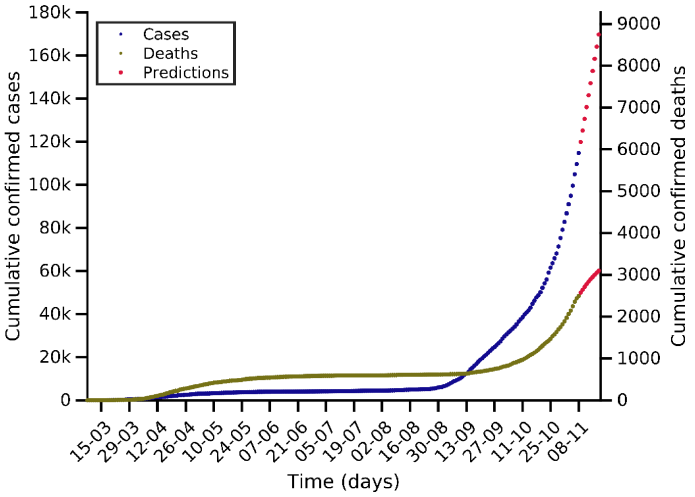








Hungary 08-11-2020. Pop: 9.7M. Cumulative incidence: 1188/10^5

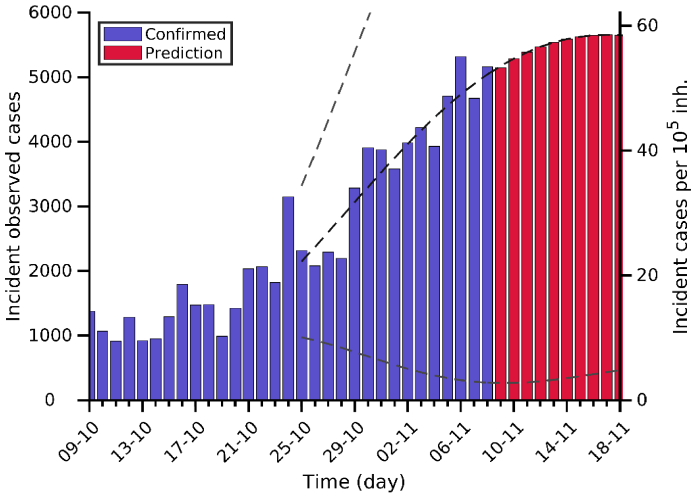


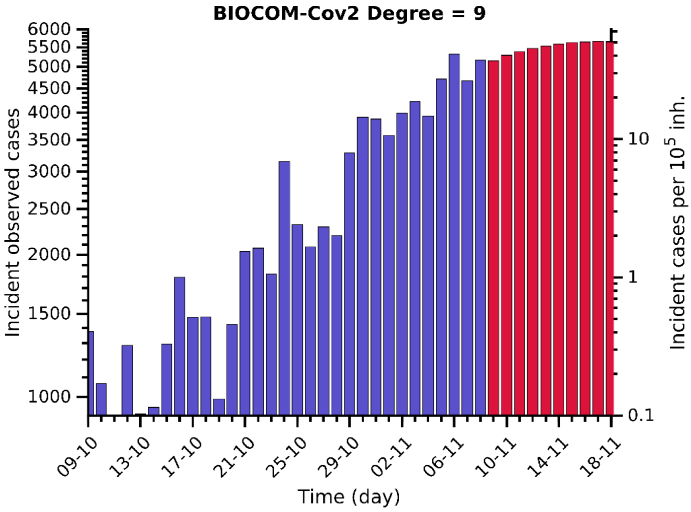
Predictions for next days

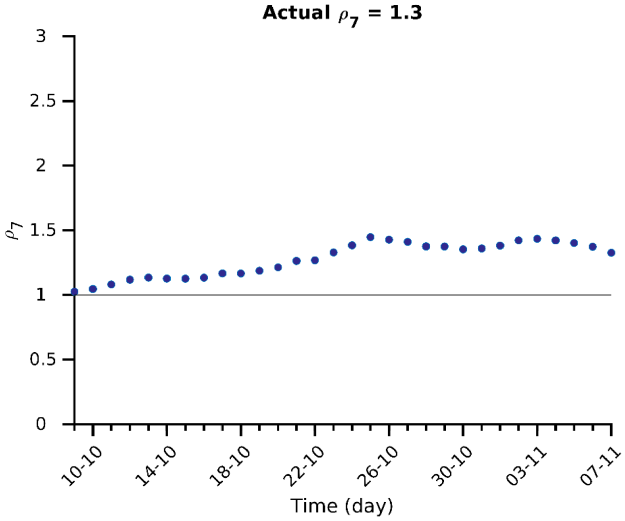
Day	Number of cases	95% Confidence Interval
11-11-2020	130599 (+15821)	[127903 - 133295]
15-11-2020	152824 (+38046)	[146494 - 159154]
18-11-2020	169779 (+55001)	[157895 - 181663]

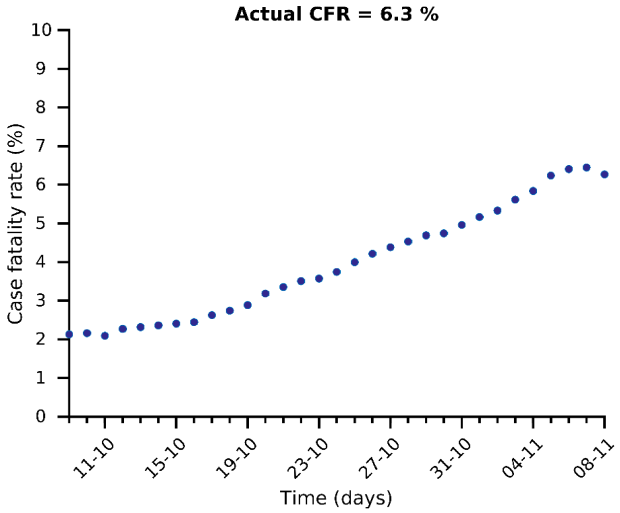
Current indicators

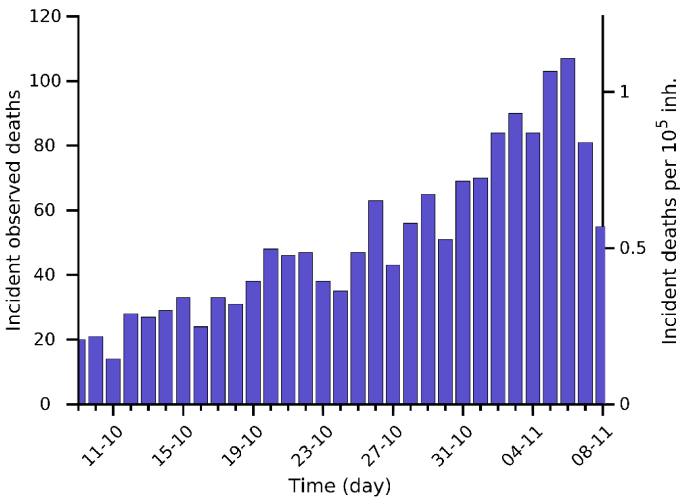
	A14	EPG	CFR	N7	D7
Today	551	731	6.27 %	4571	86
A Week ago	362	493	5.17 %	3031	60
Maximum	551	731	4.96 %	4571	88

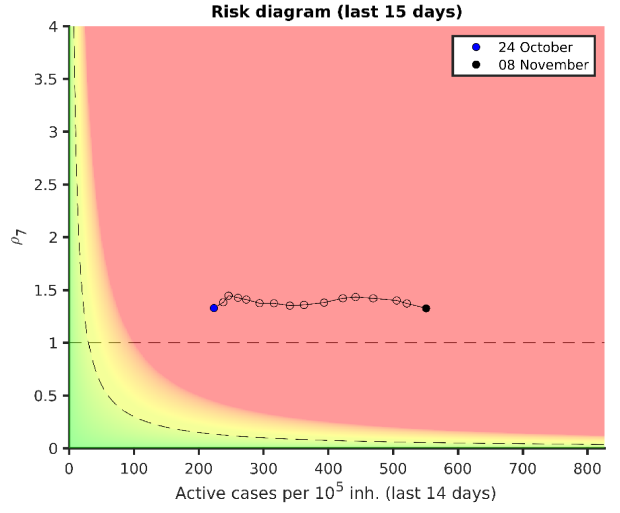




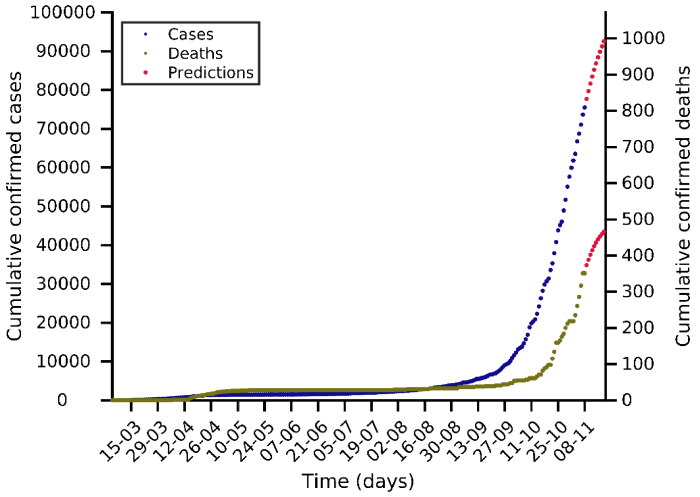








Slovakia 08-11-2020. Pop: 5.5M. Cumulative incidence: 1383/10^5

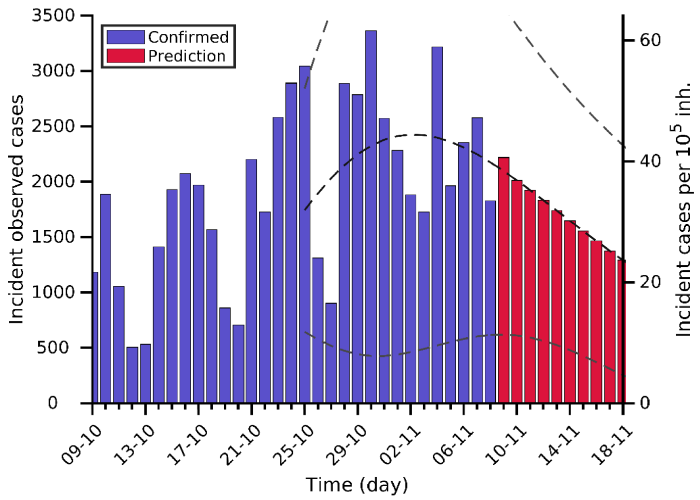


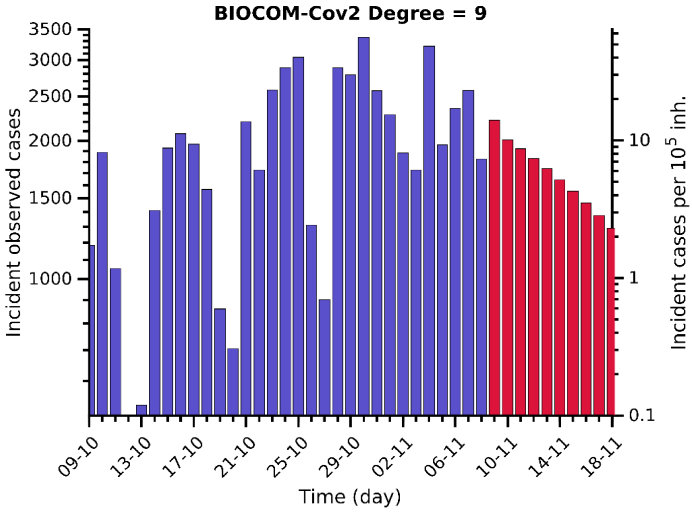
Predictions for next days

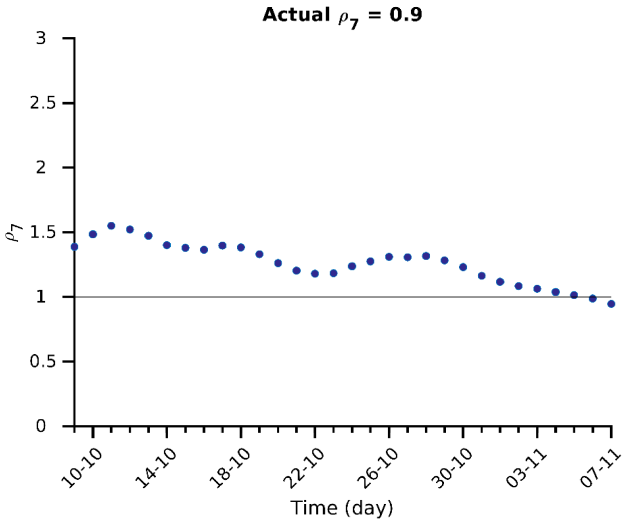
Day	Number of cases	95% Confidence Interval
11-11-2020	81648 (+6153)	[77988 - 85309]
15-11-2020	88422 (+12927)	[82709 - 94136]
18-11-2020	92553 (+17058)	[84207 - 100899]

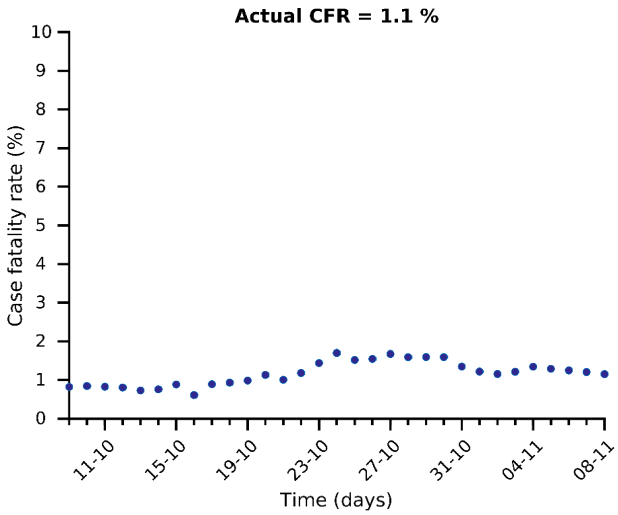
Current indicators

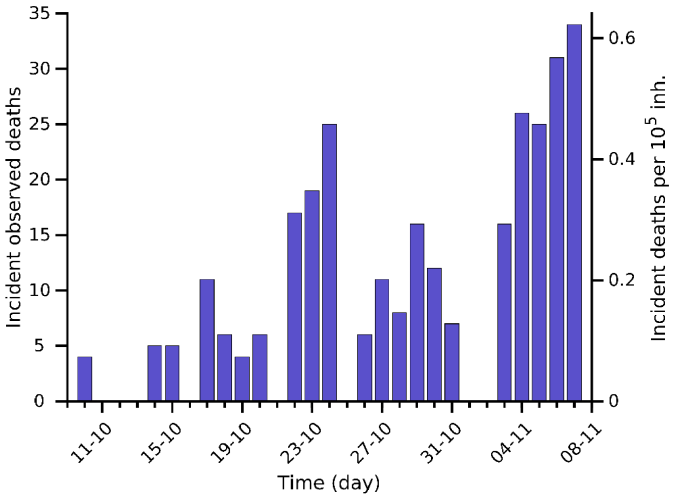
	A14	EPG	CFR	N7	D7
Today	580	548	1.15 %	2221	19
A Week ago	552	641	1.22 %	2300	9
Maximum	612	676	4.79 %	2547	19

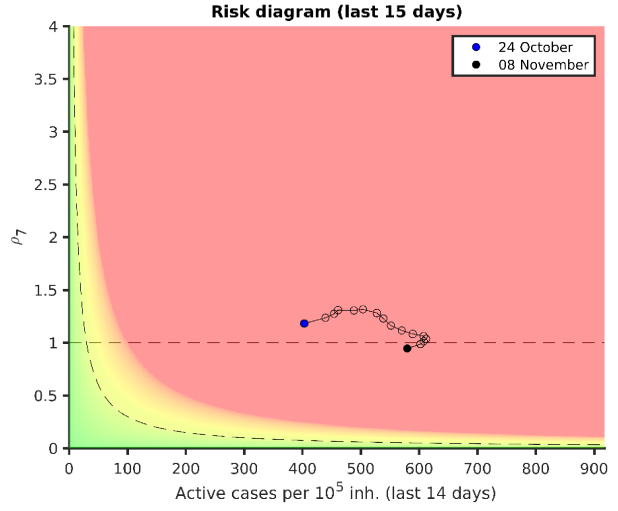




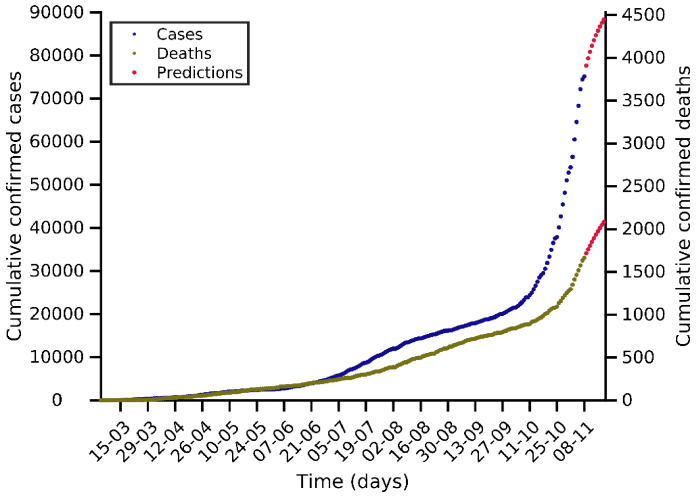








Bulgaria 08-11-2020. Pop: 6.9M. Cumulative incidence: $1082/10^5$

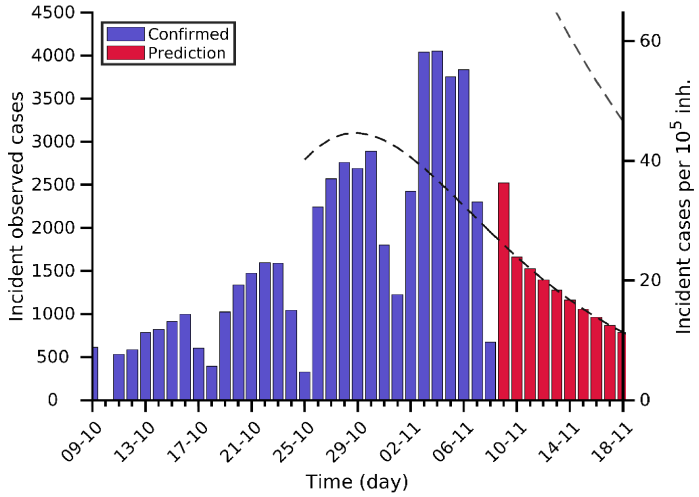


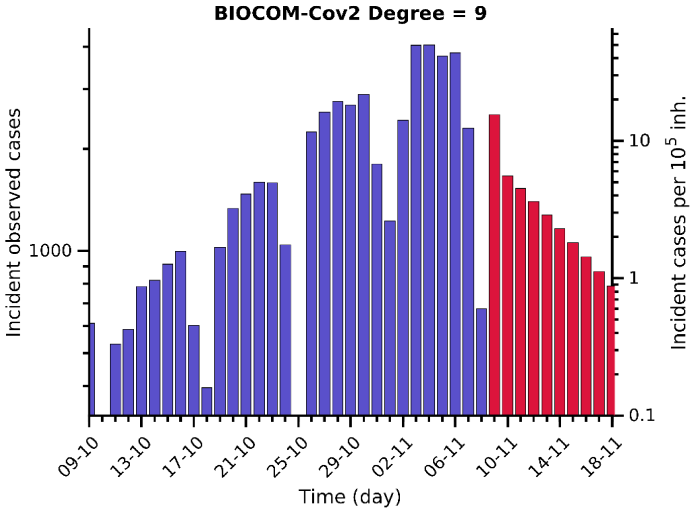
Predictions for next days

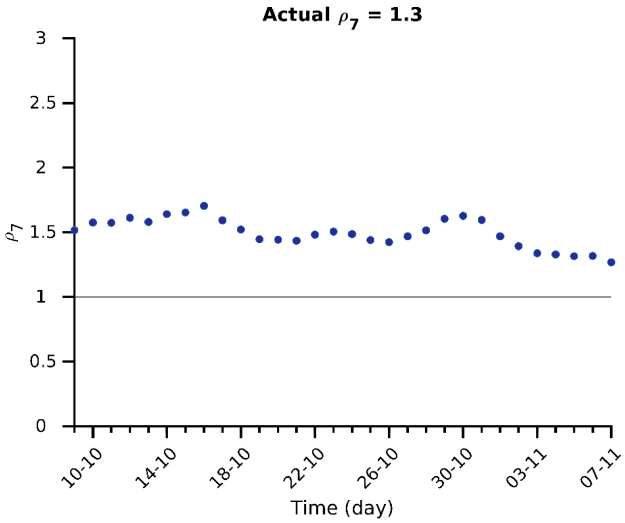
Day	Number of cases	95% Confidence Interval
11-11-2020	80873 (+5713)	[75160 - 94234]
15-11-2020	85770 (+10610)	[75160 - 103243]
18-11-2020	88388 (+13228)	[75160 - 110547]

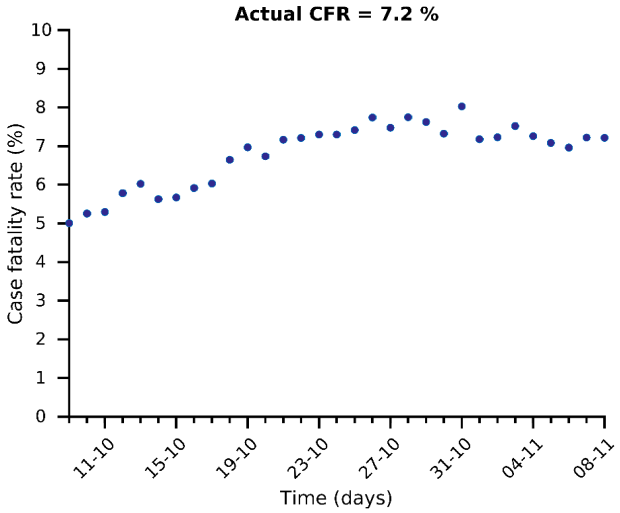
Current indicators

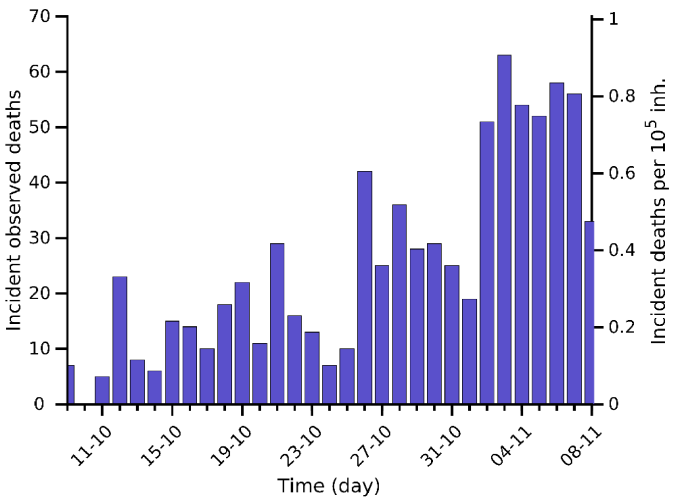
	A14	EPG	CFR	N7	D7
Today	536	680	7.21 %	3013	52
A Week ago	354	564	7.18 %	2311	29
Maximum	536	700	4.99 %	3092	52

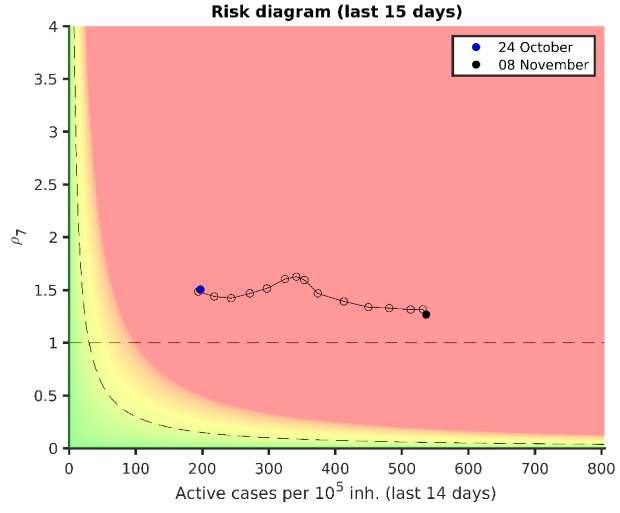




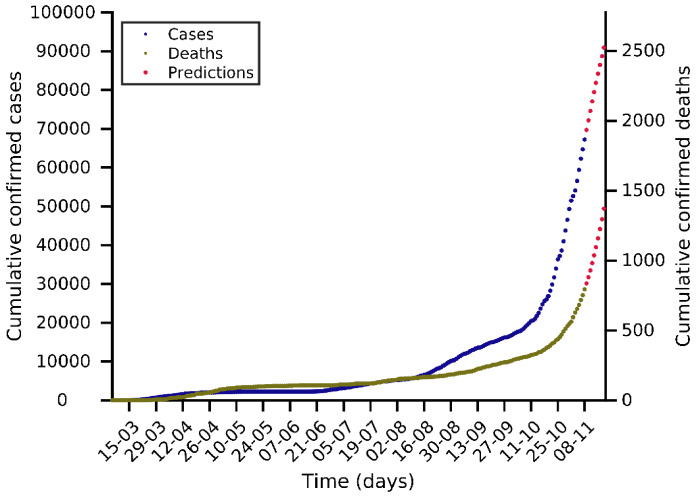








Croatia 08-11-2020. Pop: 4.1M. Cumulative incidence: 1638/10^5

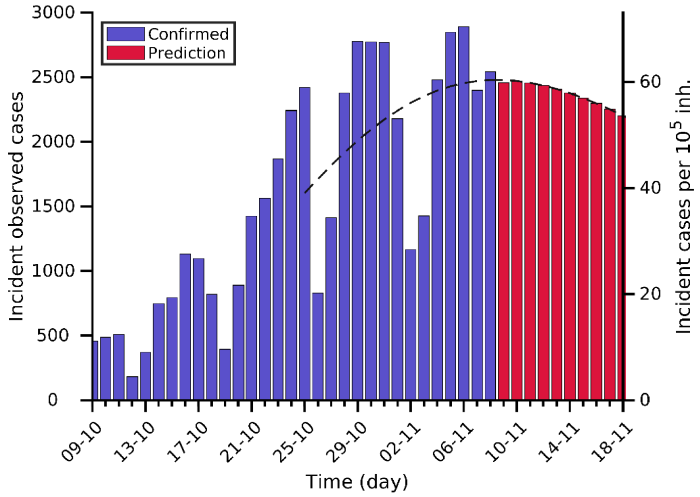


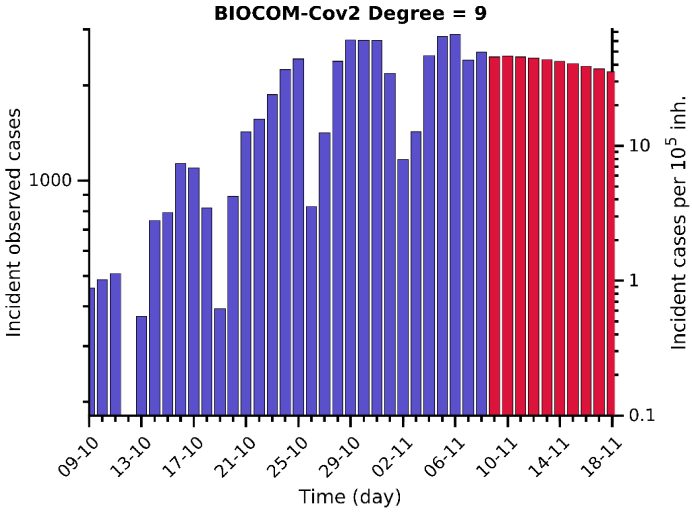
Predictions for next days

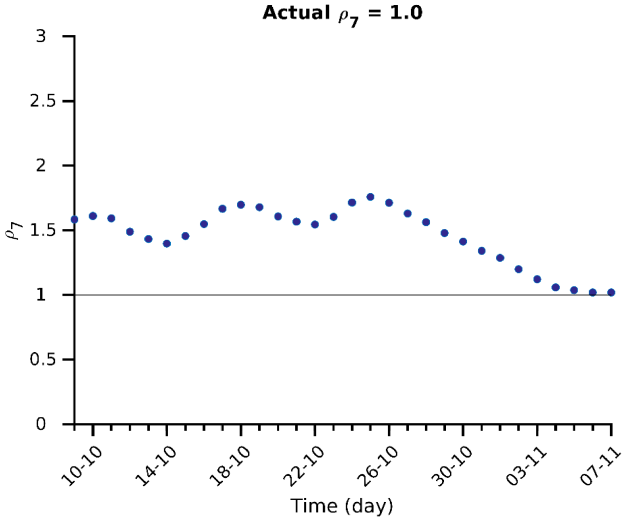
Day	Number of cases	95% Confidence Interval
11-11-2020	74632 (+7385)	[71691 - 77572]
15-11-2020	84190 (+16943)	[78390 - 89991]
18-11-2020	90939 (+23692)	[80973 - 100906]

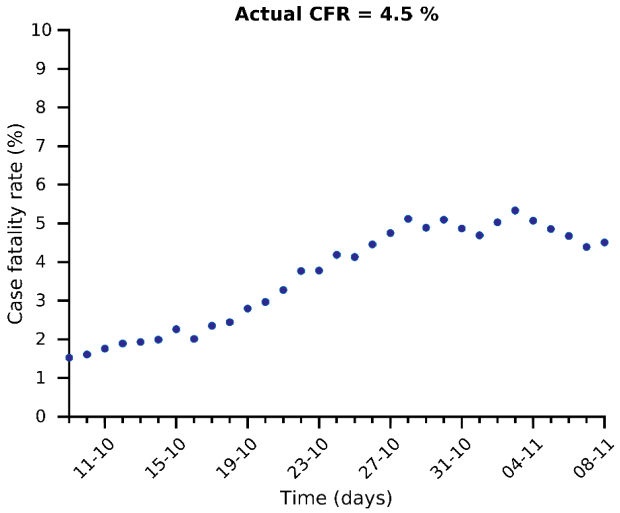
Current indicators

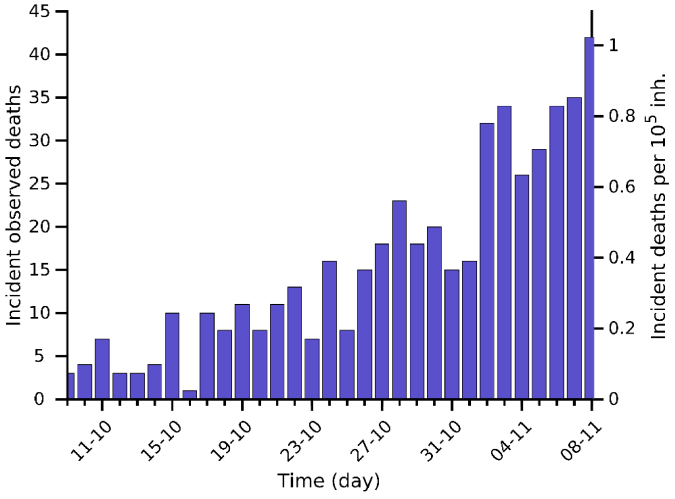
	A14	EPG	CFR	N7	D7
Today	752	766	4.51 %	2250	33
A Week ago	631	846	4.69 %	2159	18
Maximum	752	846	4.90 %	2251	33

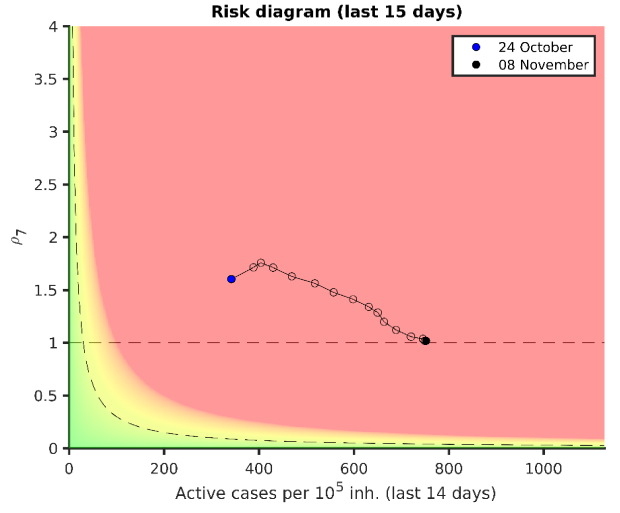




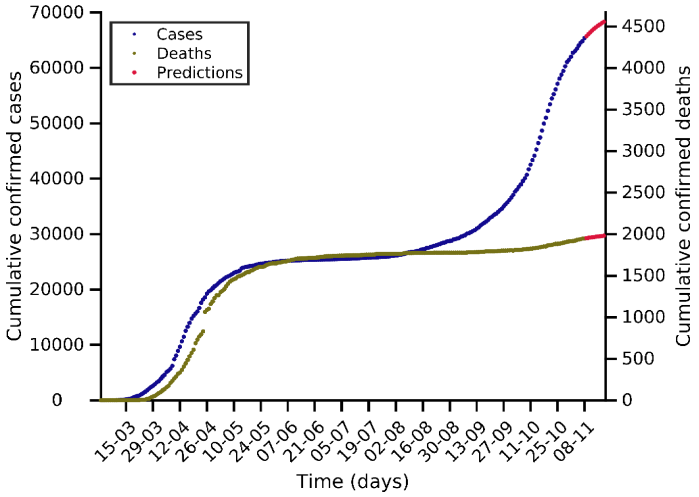








Ireland 08-11-2020. Pop: 4.9M. Cumulative incidence: 1324/10^5

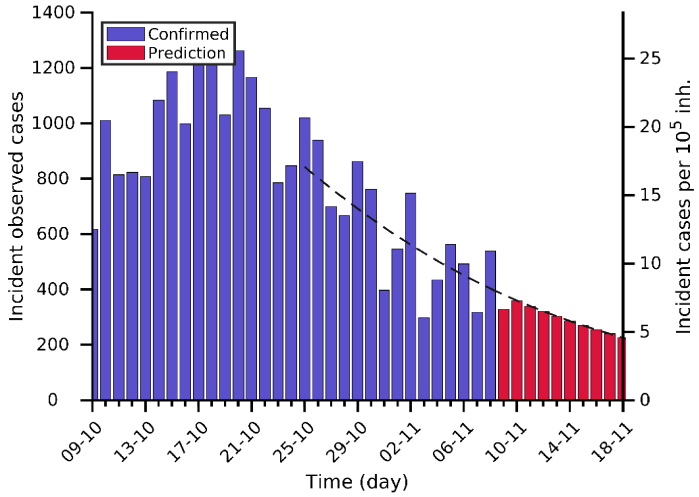


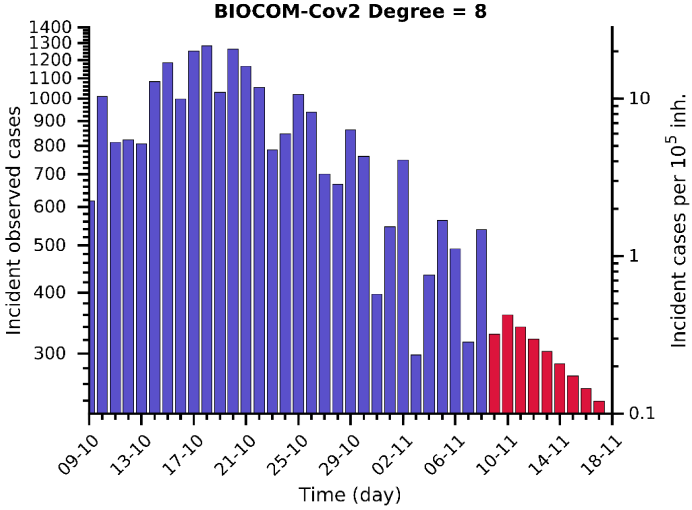
Predictions for next days

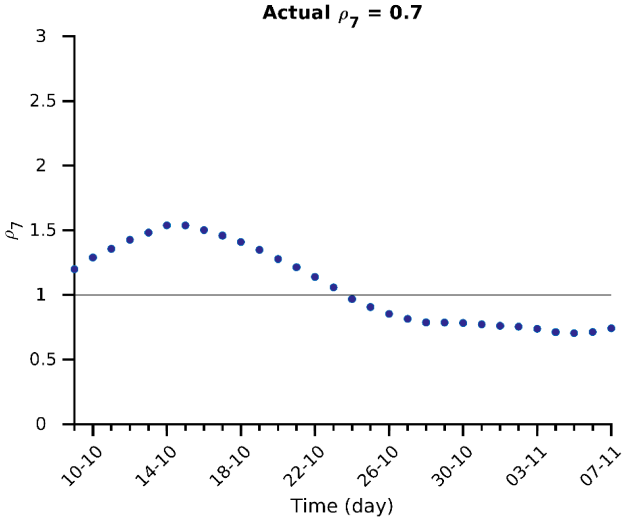
Day	Number of cases	95% Confidence Interval
11-11-2020	66423 (+1029)	[65409 - 67436]
15-11-2020	67602 (+2208)	[66446 - 68759]
18-11-2020	68322 (+2928)	[67044 - 69600]

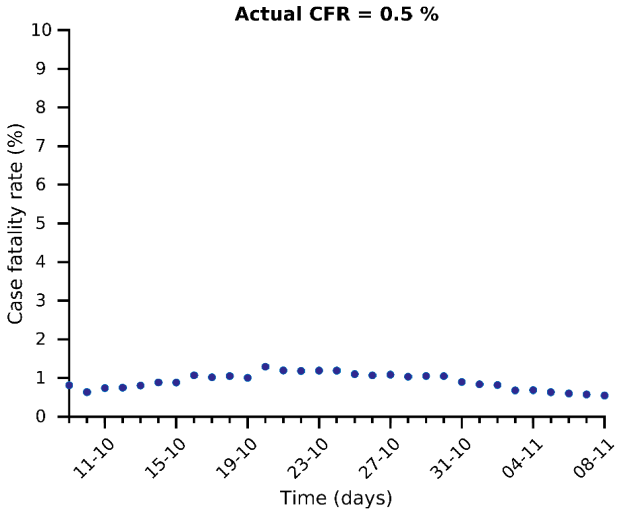
Current indicators

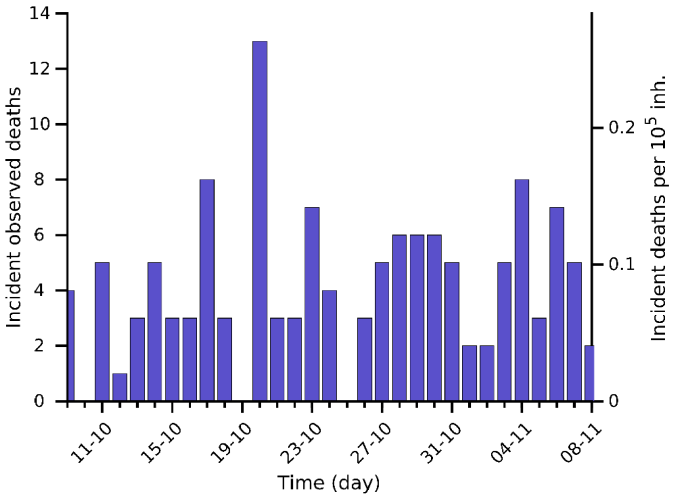
	A14	EPG	CFR	N7	D7
Today	167	124	0.54 %	485	5
A Week ago	244	188	0.84 %	696	5
Maximum	298	363	4.93 %	1168	70

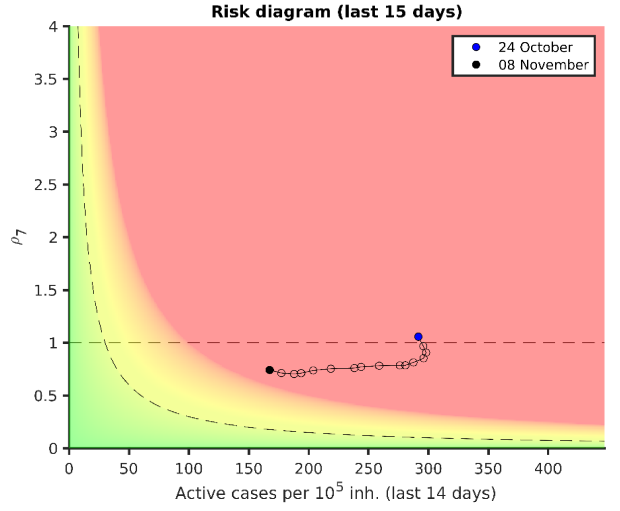




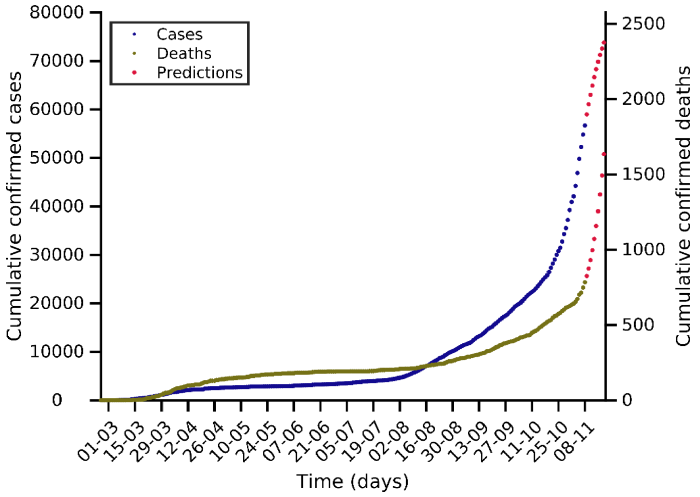








Greece 08-11-2020. Pop: 10.4M. Cumulative incidence: 544/10^5

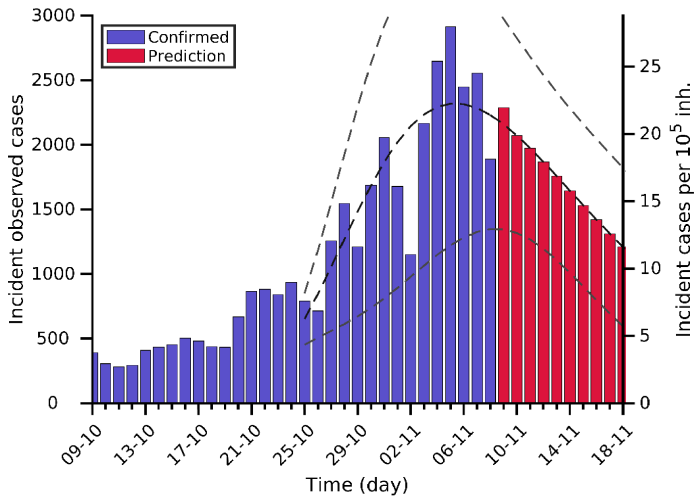


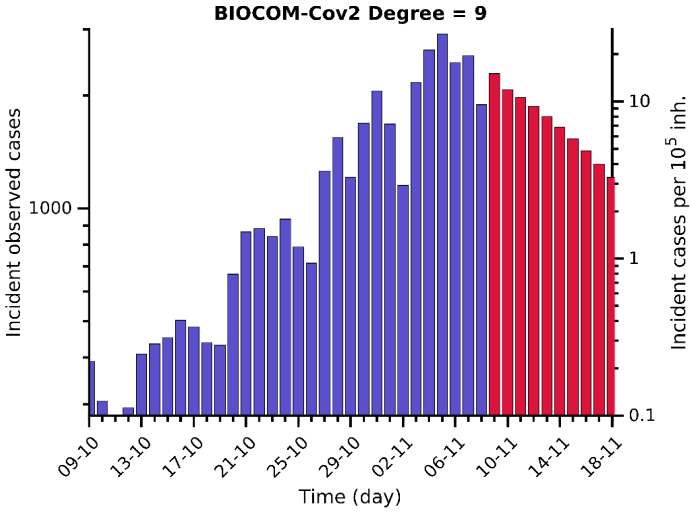
Predictions for next days

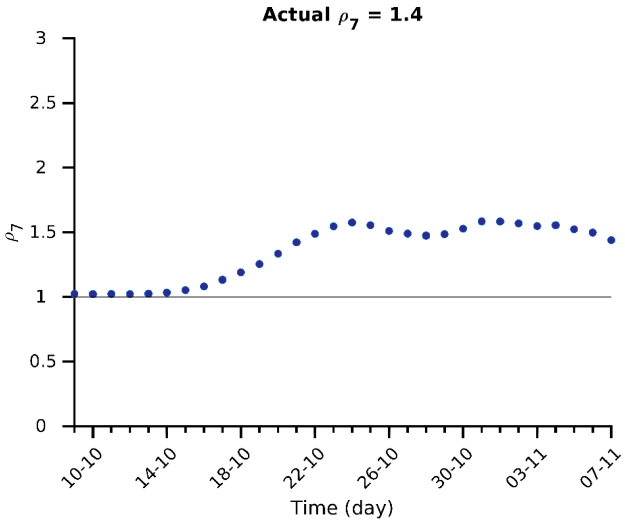
Day	Number of cases	95% Confidence Interval
11-11-2020	63031 (+6333)	[59929 - 66134]
15-11-2020	69833 (+13135)	[64891 - 74776]
18-11-2020	73776 (+17078)	[66652 - 80900]

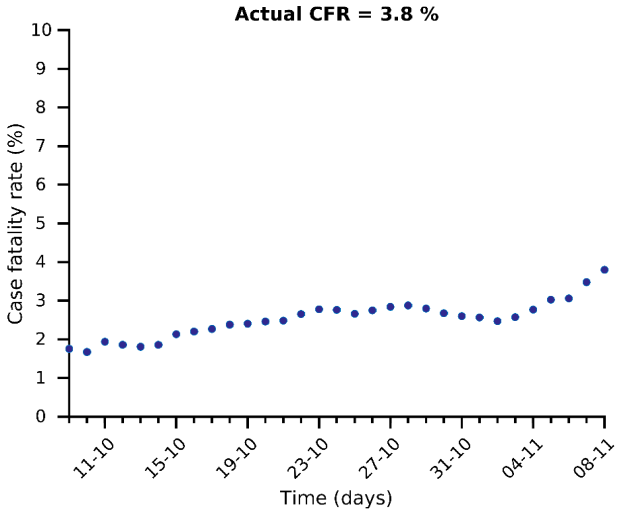
Current indicators

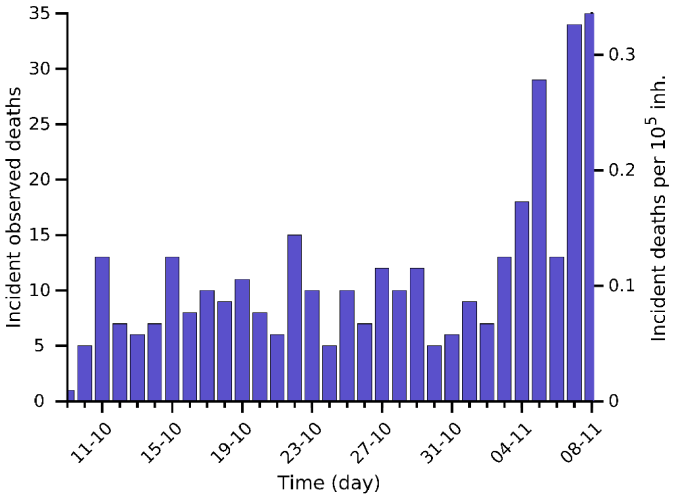
	A14	EPG	CFR	N7	D7
Today	249	358	3.80 %	2253	21
A Week ago	149	236	2.56 %	1450	9
Maximum	249	358	4.95 %	2253	21

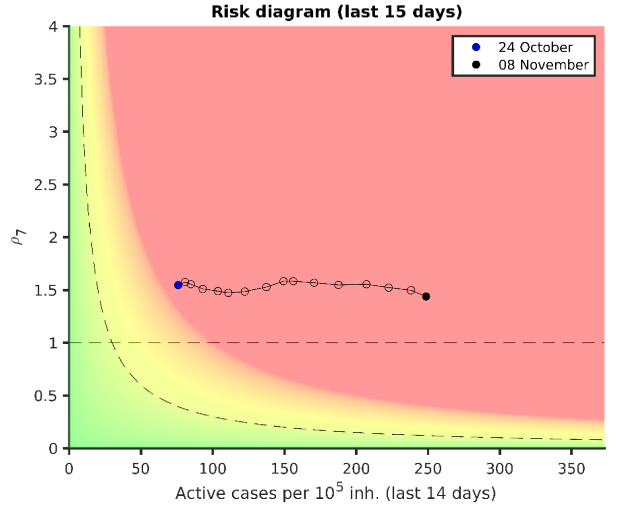




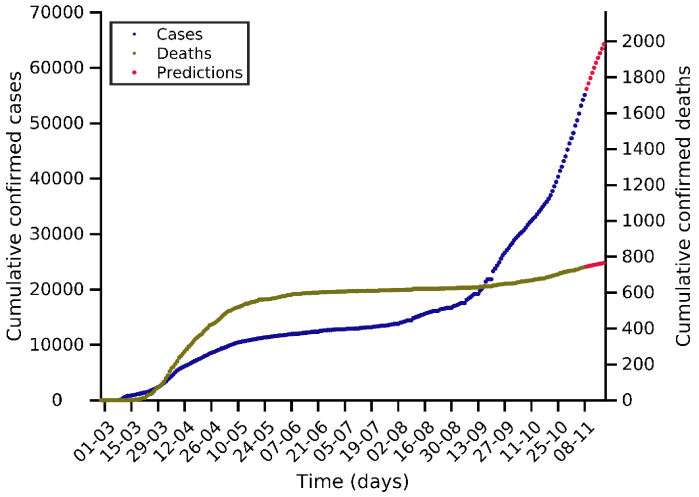








Denmark 08-11-2020. Pop: 5.8M. Cumulative incidence: 952/10⁵

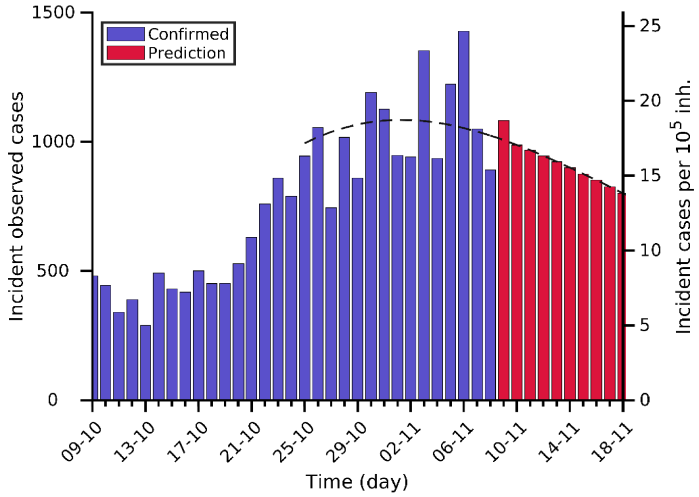


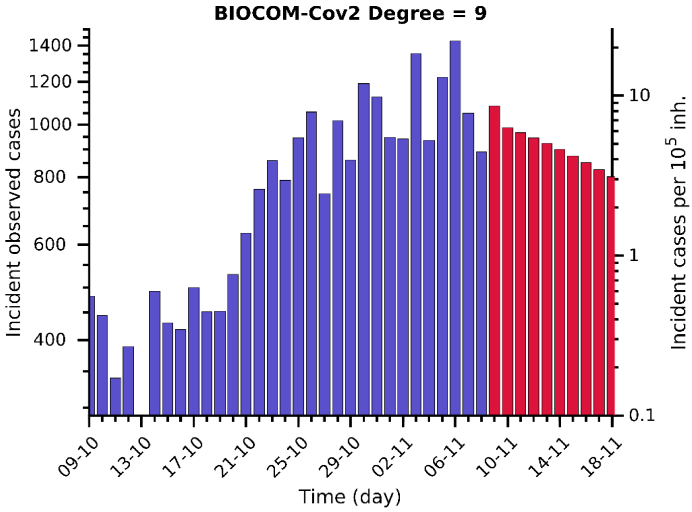
Predictions for next days

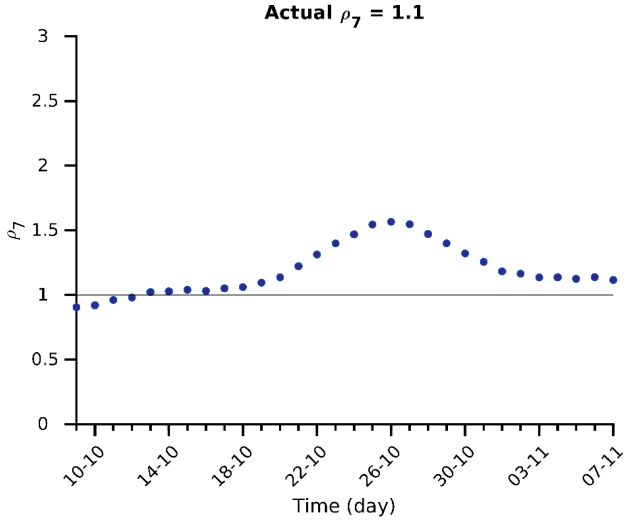
Day	Number of cases	95% Confidence Interval
11-11-2020	58158 (+3037)	[56465 - 59852]
15-11-2020	61803 (+6682)	[58755 - 64851]
18-11-2020	64282 (+9161)	[59282 - 69281]

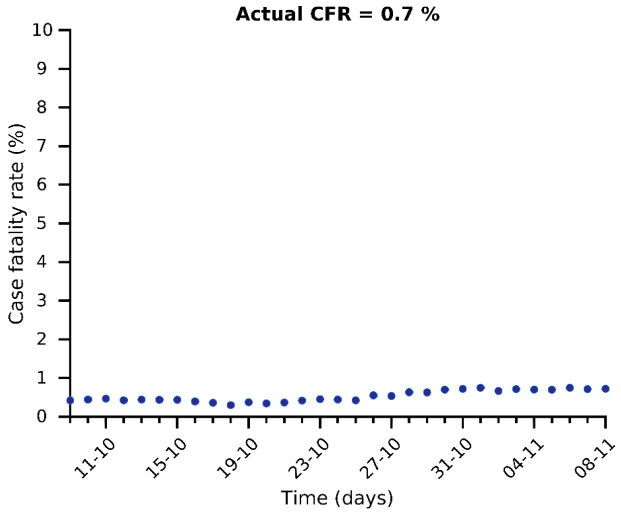
Current indicators

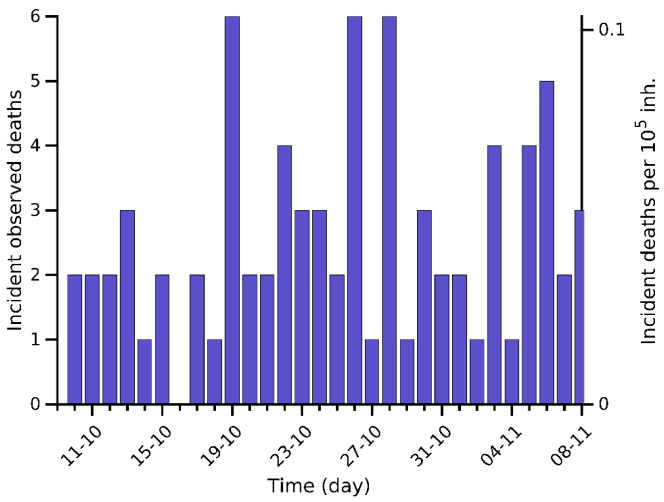
	A14	EPG	CFR	N7	D7
Today	255	284	0.72 %	1117	3
A Week ago	206	258	0.74 %	992	3
Maximum	256	324	4.41 %	1136	16

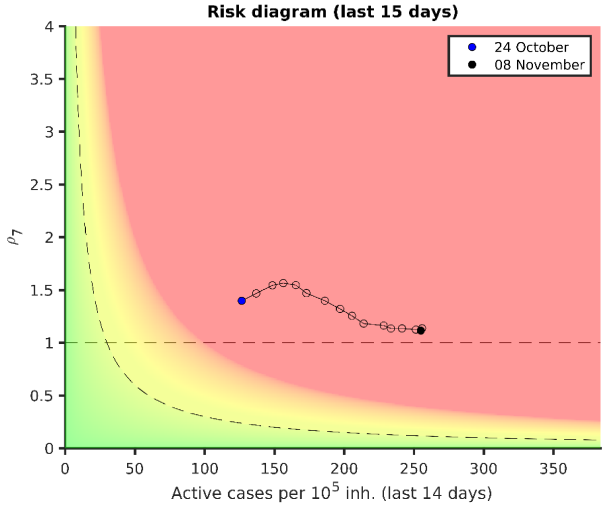




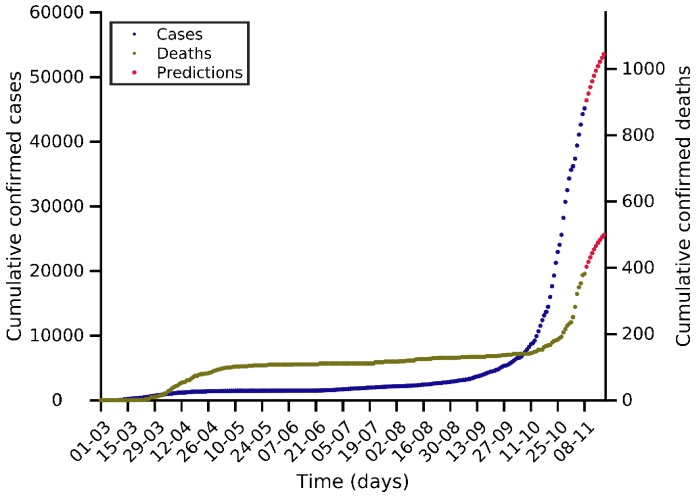








Slovenia 08-11-2020. Pop: 2.1M. Cumulative incidence: 2172/10^5

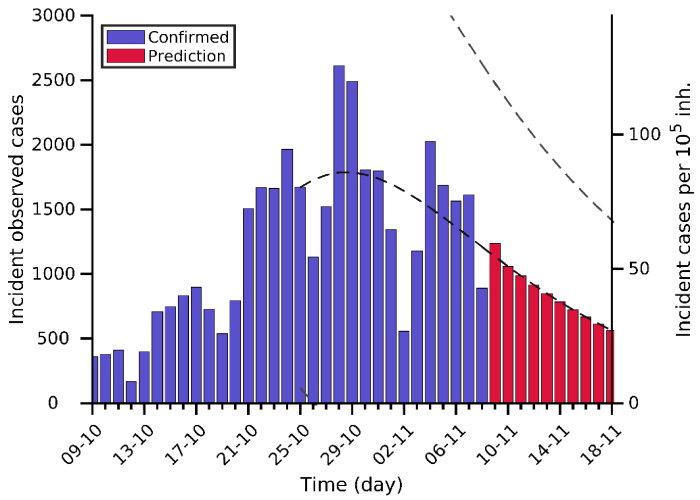


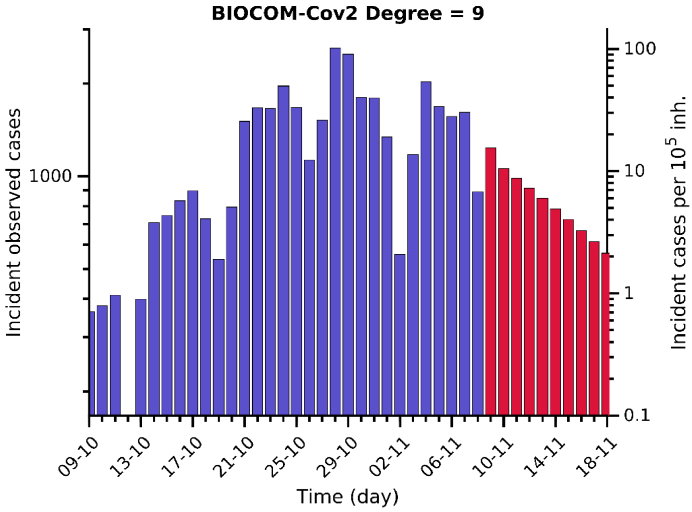
Predictions for next days

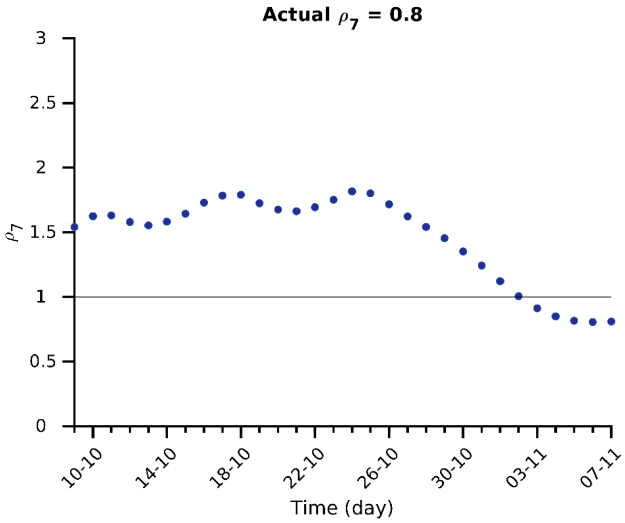
Day	Number of cases	95% Confidence Interval
11-11-2020	48442 (+3281)	[45161 - 51725]
15-11-2020	51713 (+6552)	[47192 - 56234]
18-11-2020	53556 (+8395)	[47541 - 59571]

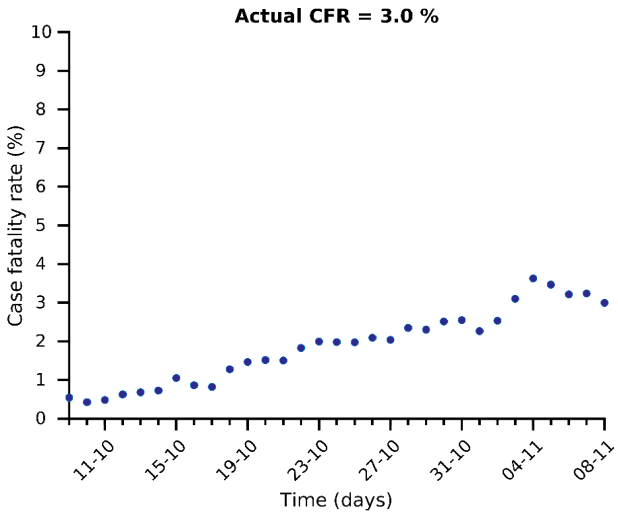
Current indicators

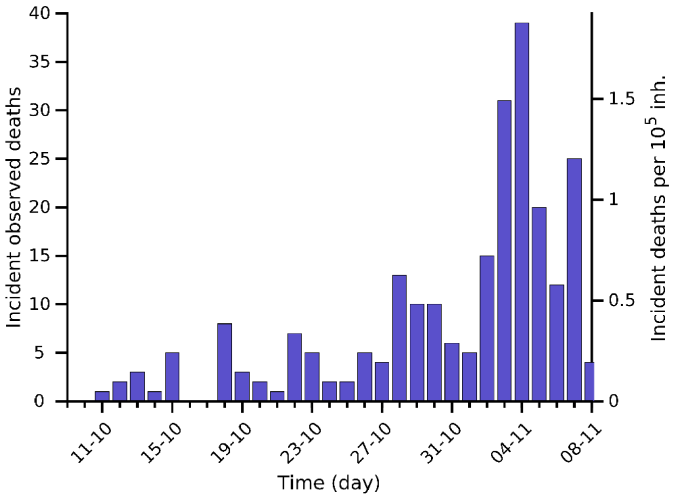
	A14	EPG	CFR	N7	D7
Today	1068	865	2.99 %	1359	21
A Week ago	1083	1345	2.26 %	1814	8
Maximum	1128	1484	4.97 %	1885	21

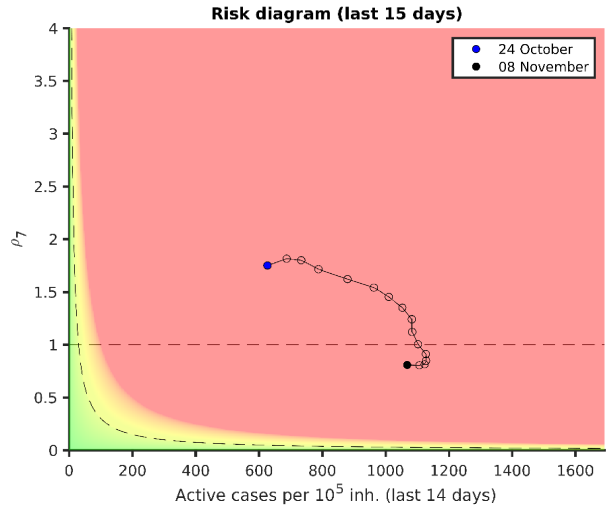




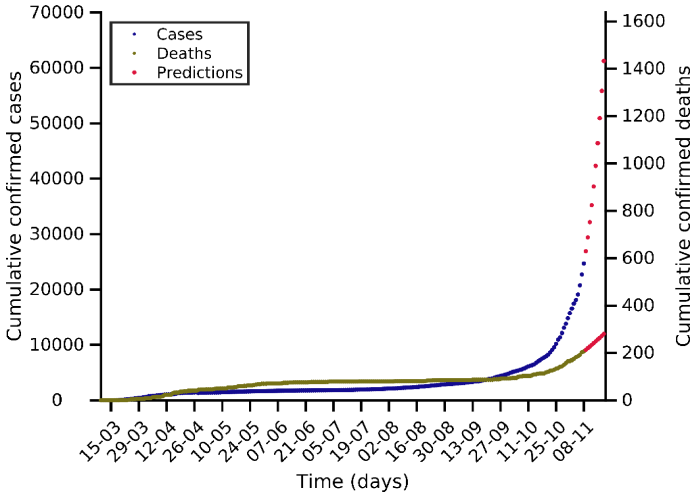








Lithuania 08-11-2020. Pop: 2.7M. Cumulative incidence: $907/10^5$

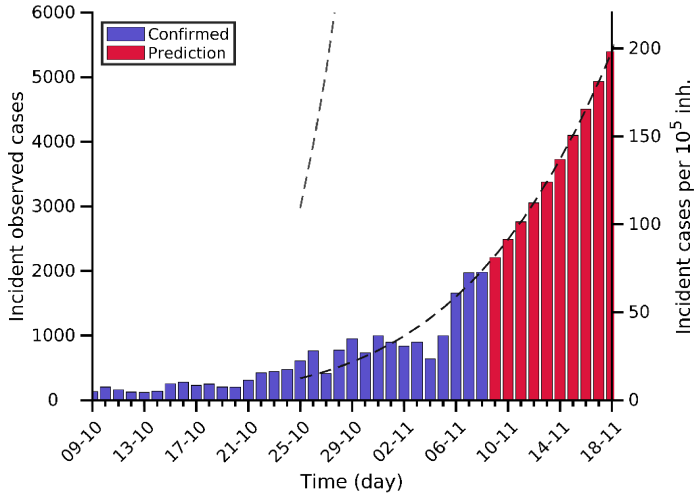


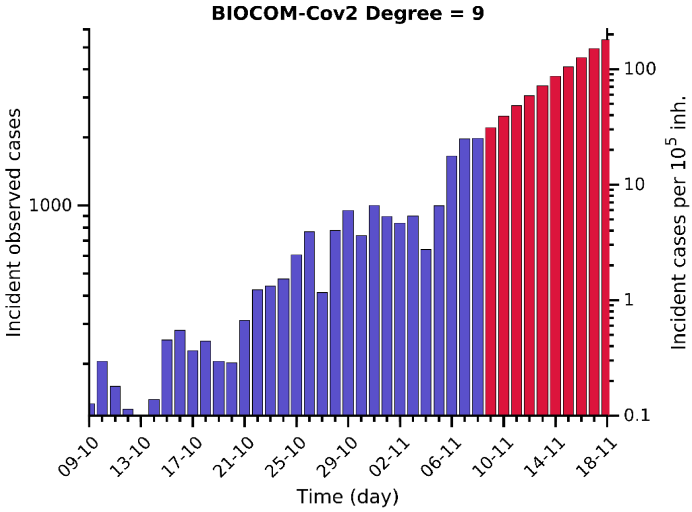
Predictions for next days

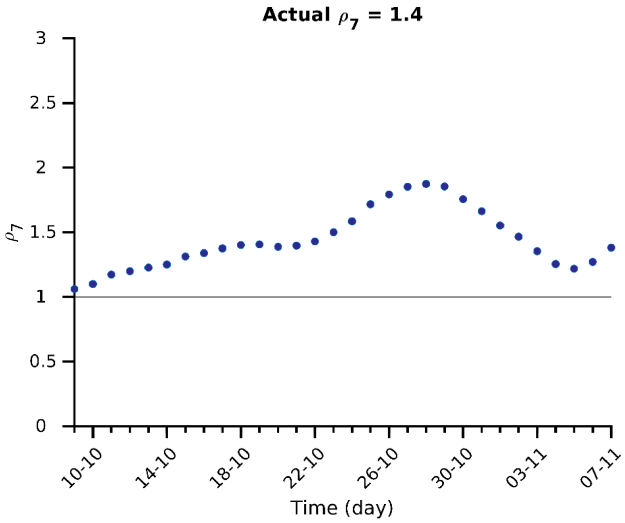
Day	Number of cases	95% Confidence Interval
11-11-2020	32154 (+7455)	[28030 - 36278]
15-11-2020	46413 (+21714)	[27821 - 65005]
18-11-2020	61247 (+36548)	[24699 - 108794]

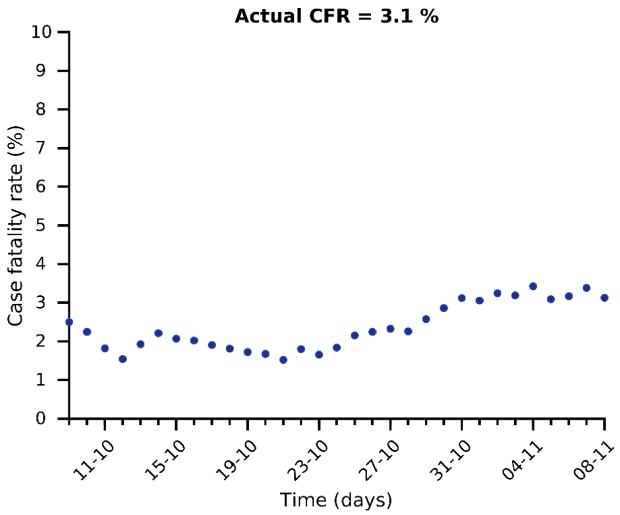
Current indicators

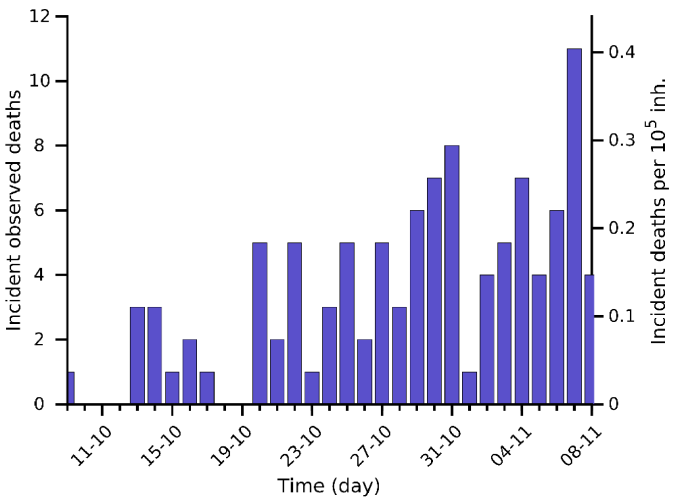
	A14	EPG	CFR	N7	D7
Today	533	736	3.12 %	1283	6
A Week ago	301	501	3.05 %	791	5
Maximum	533	736	4.93 %	1283	6

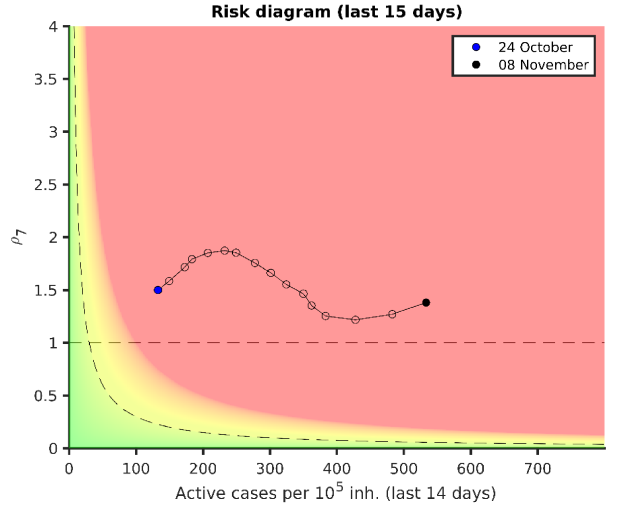




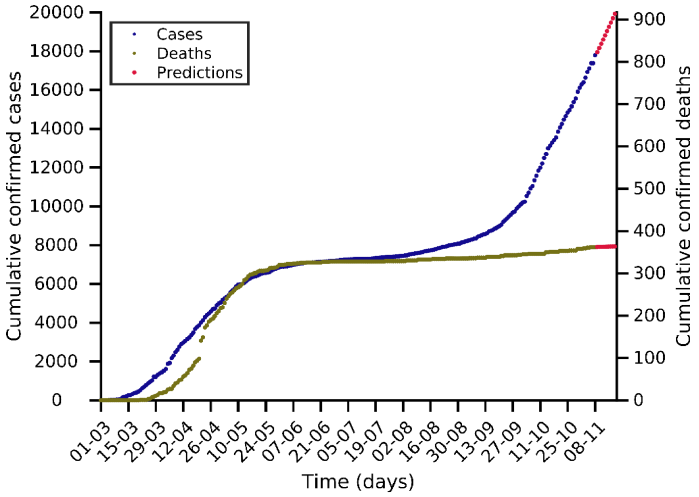








Finland 08-11-2020. Pop: 5.5M. Cumulative incidence: 321/10⁵

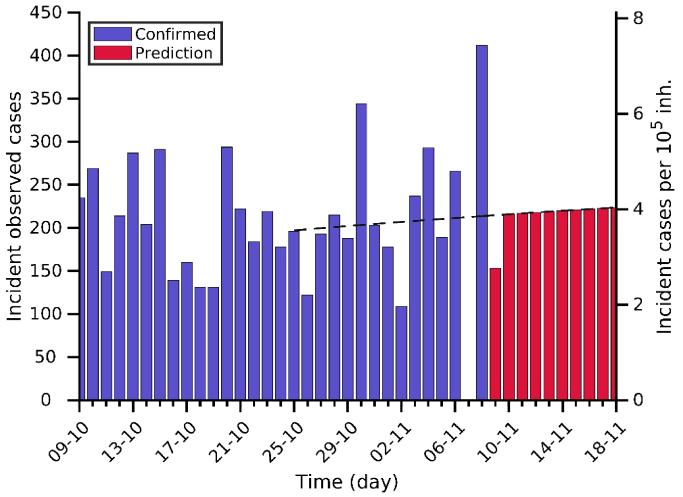


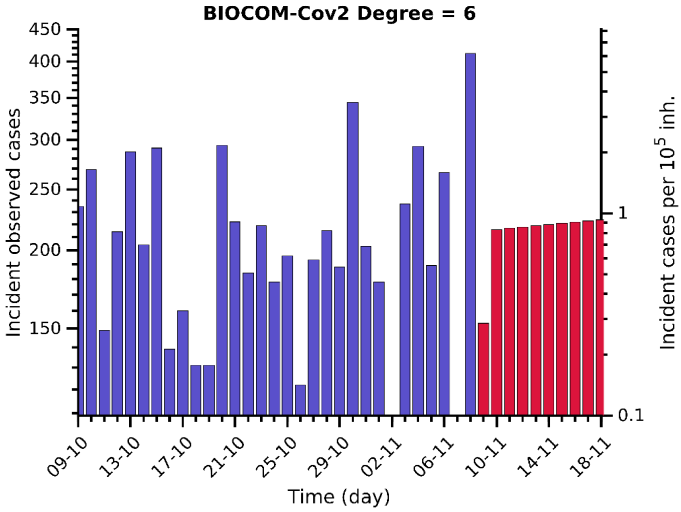
Predictions for next days

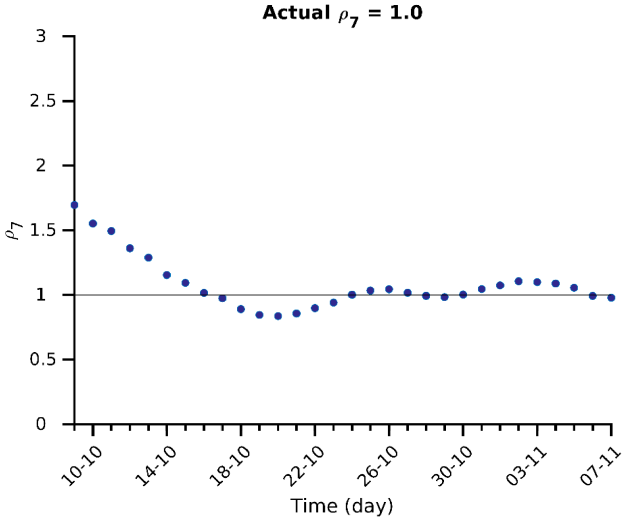
Day	Number of cases	95% Confidence Interval
11-11-2020	18383 (+586)	[17797 - 20150]
15-11-2020	19260 (+1463)	[17797 - 23286]
18-11-2020	19929 (+2132)	[17797 - 27660]

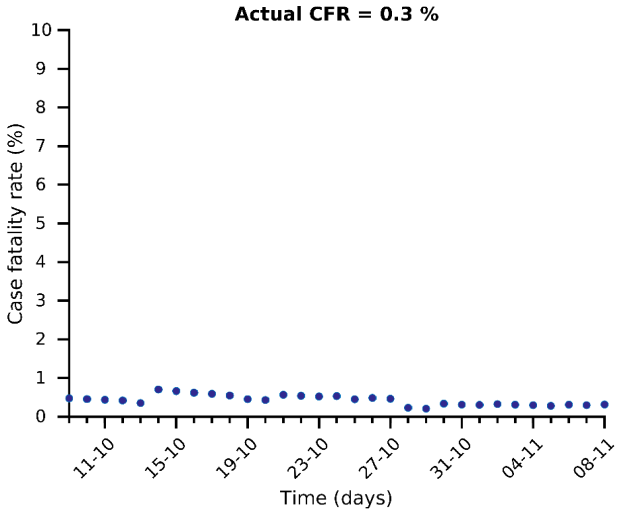
Current indicators

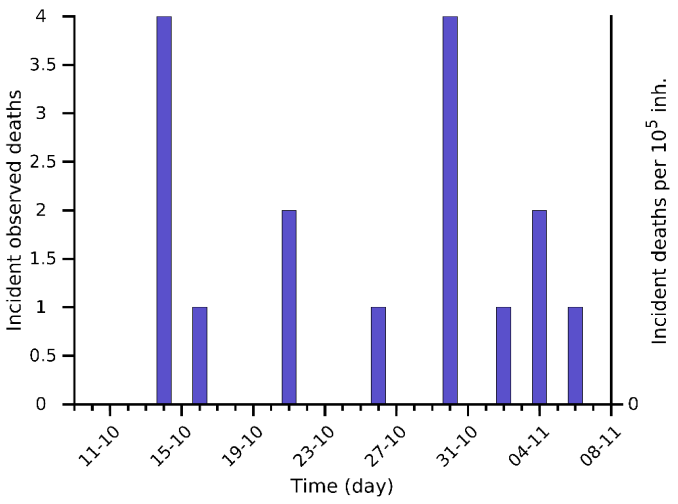
	A14	EPG	CFR	N7	D7
Today	53	52	0.31 %	215	1
A Week ago	52	54	0.30 %	206	1
Maximum	55	70	4.90 %	236	14

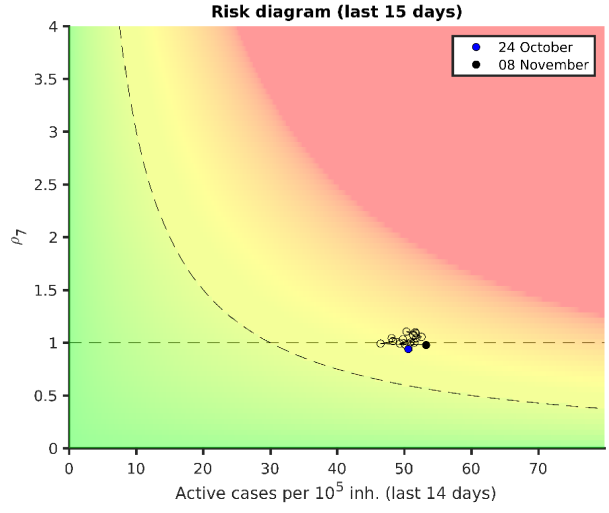




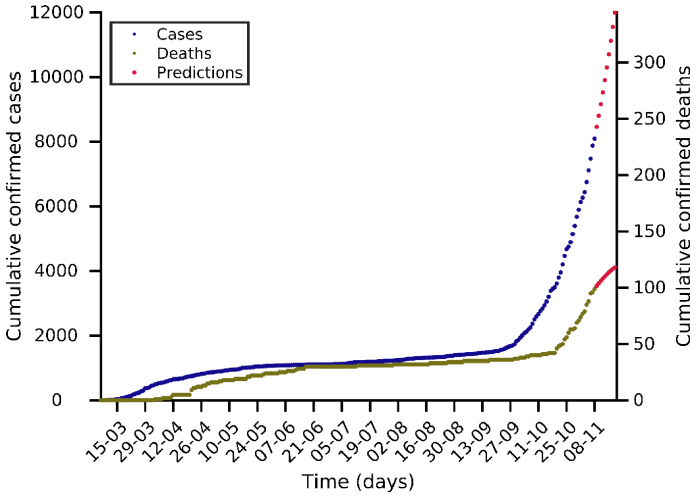








Latvia 08-11-2020. Pop: 1.9M. Cumulative incidence: 429/10^5

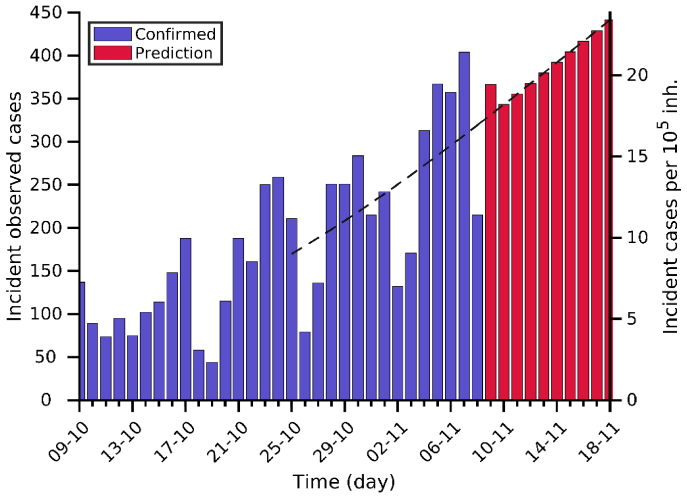


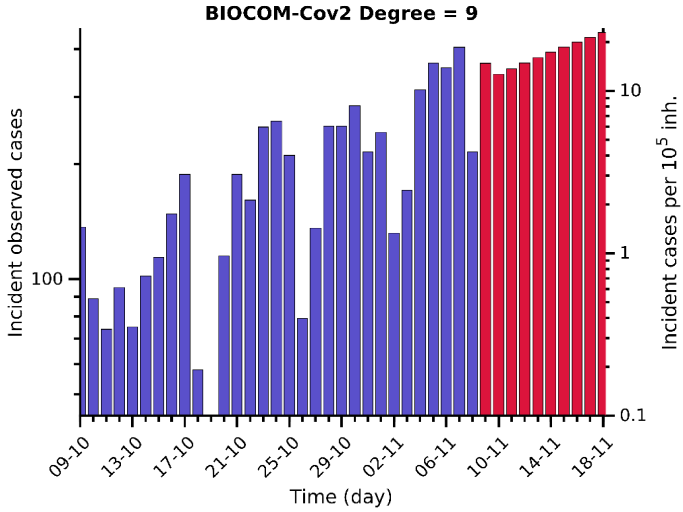
Predictions for next days

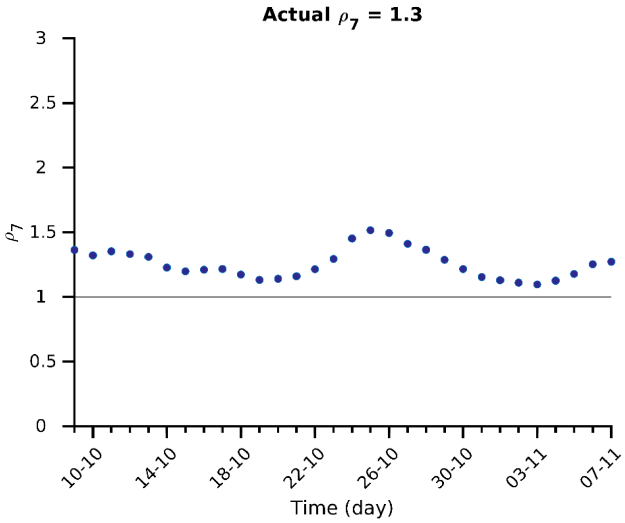
Day	Number of cases	95% Confidence Interval
11-11-2020	9160 (+1065)	[8171 - 10150]
15-11-2020	10704 (+2609)	[8095 - 13398]
18-11-2020	11992 (+3897)	[8095 - 17587]

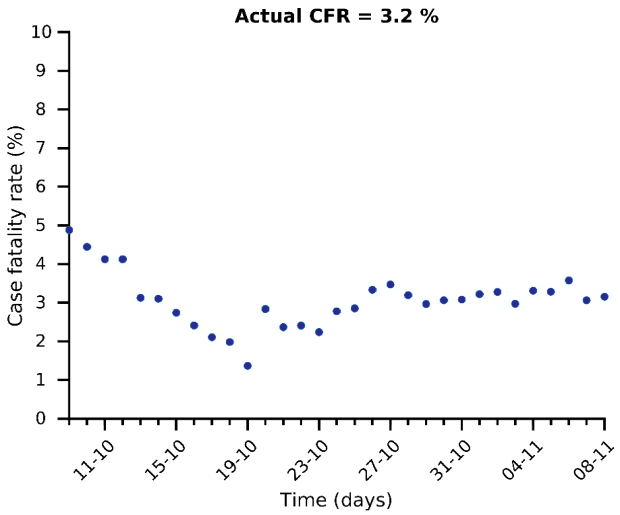
Current indicators

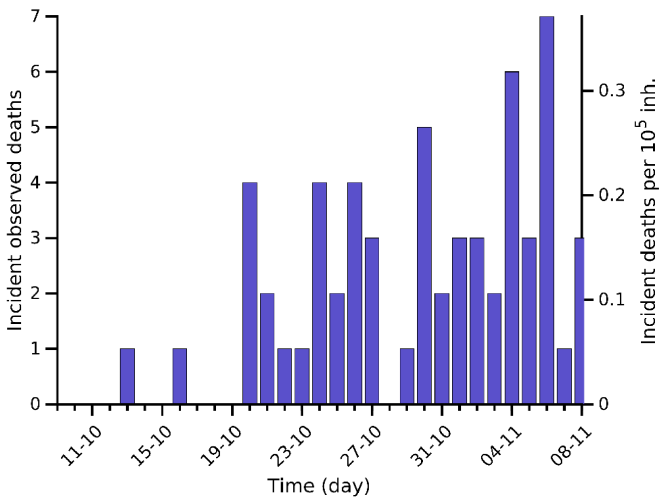
	A14	EPG	CFR	N7	D7
Today	181	230	3.15 %	280	4
A Week ago	142	164	3.22 %	208	3
Maximum	181	230	4.88 %	284	4

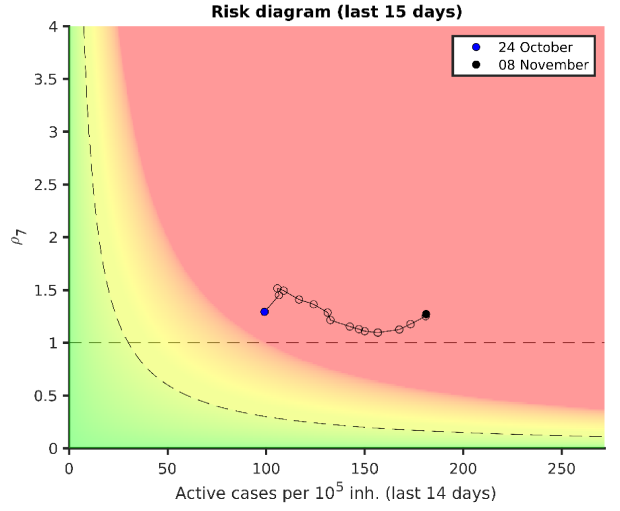




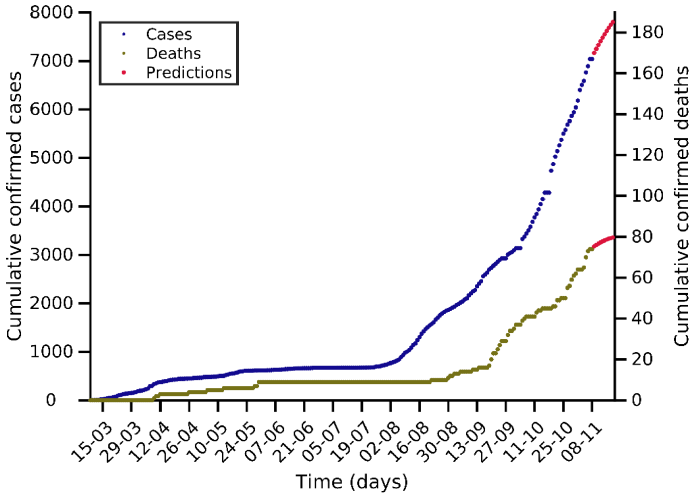








Malta 08-11-2020. Pop: 0.4M. Cumulative incidence: 1594/10^5

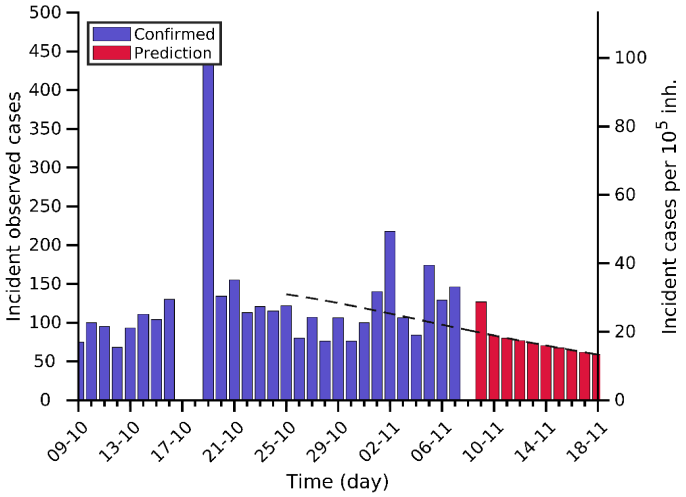


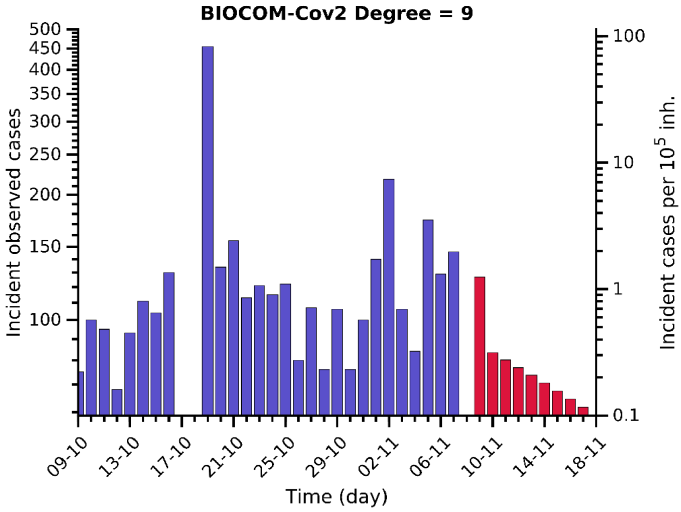
Predictions for next days

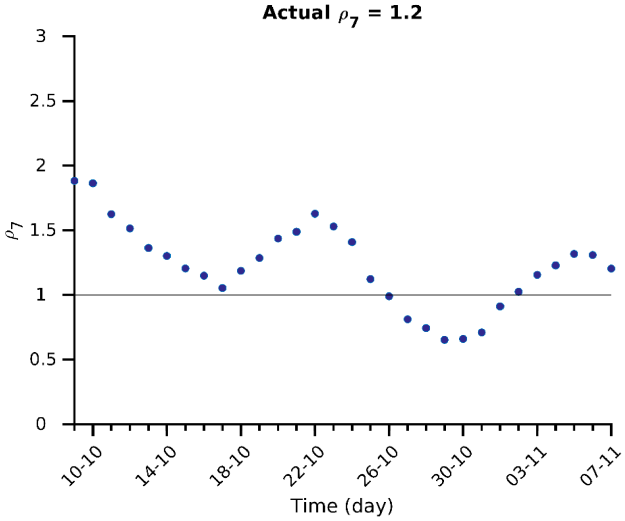
Day	Number of cases	95% Confidence Interval
11-11-2020	7329 (+290)	[7039 - 8095]
15-11-2020	7618 (+579)	[7039 - 8854]
18-11-2020	7803 (+764)	[7039 - 9699]

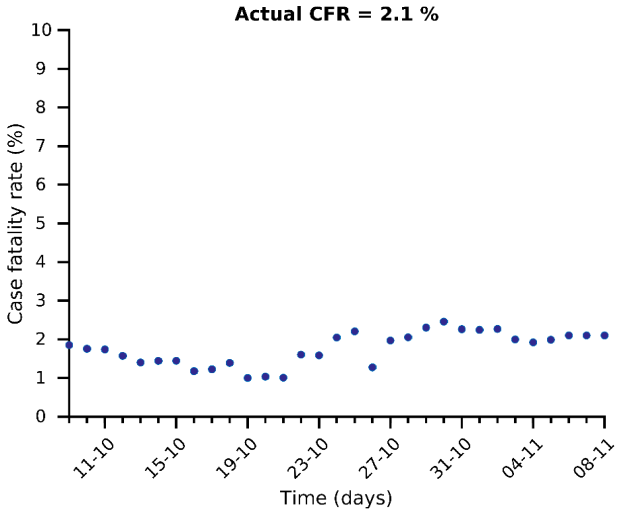
Current indicators

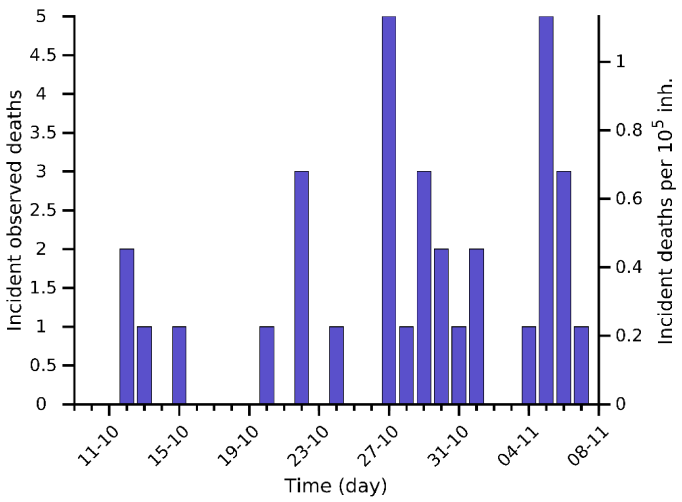
	A14	EPG	CFR	N7	D7
Today	349	420	2.10 %	122	1
A Week ago	430	305	2.24 %	98	2
Maximum	430	619	4.92 %	174	2

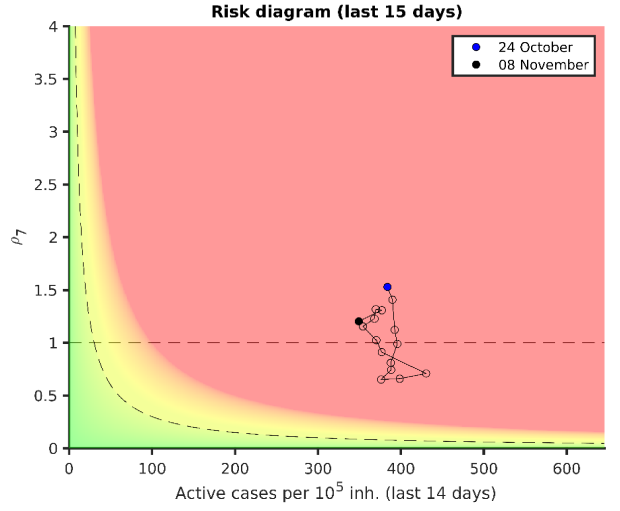




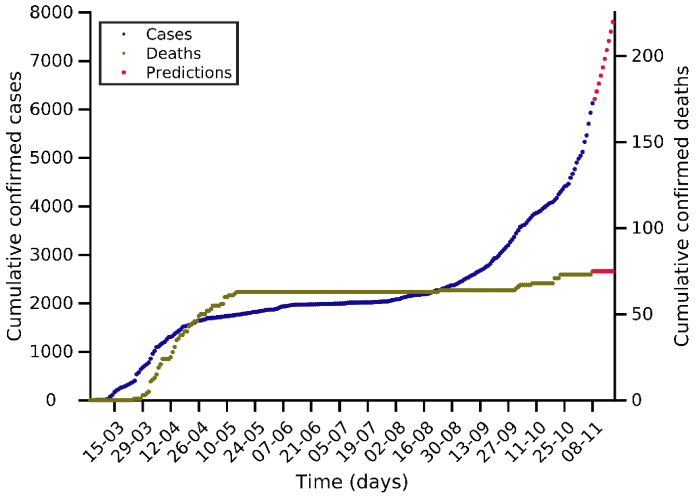








Estonia 08-11-2020. Pop: 1.3M. Cumulative incidence: 462/10⁵

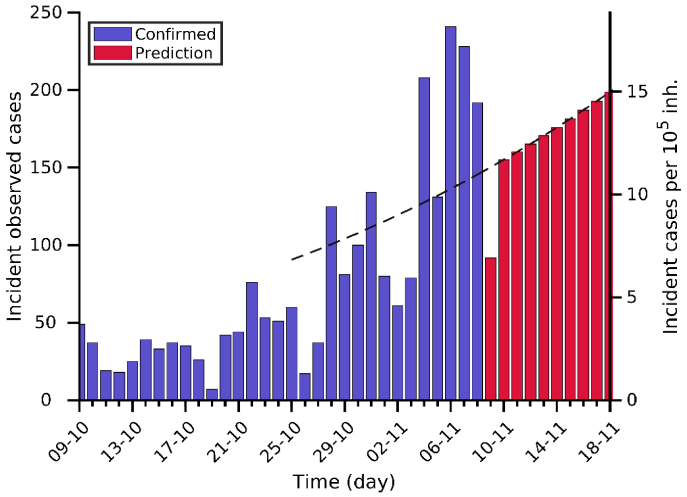


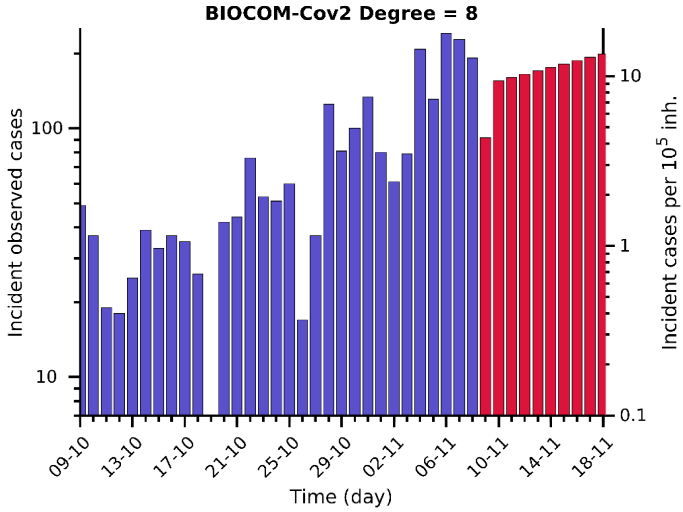
Predictions for next days

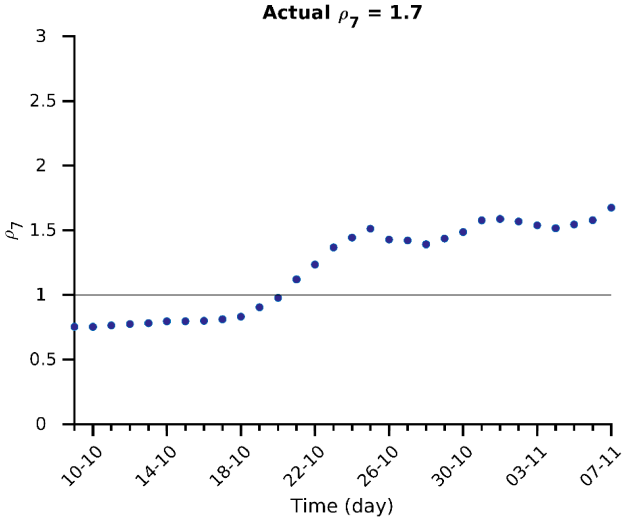
Day	Number of cases	95% Confidence Interval
11-11-2020	6532 (+407)	[6125 - 7737]
15-11-2020	7225 (+1100)	[6125 - 10547]
18-11-2020	7804 (+1679)	[6125 - 14810]

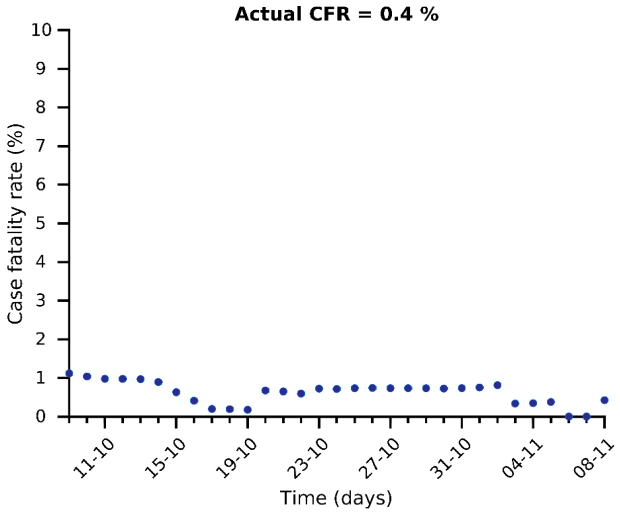
Current indicators

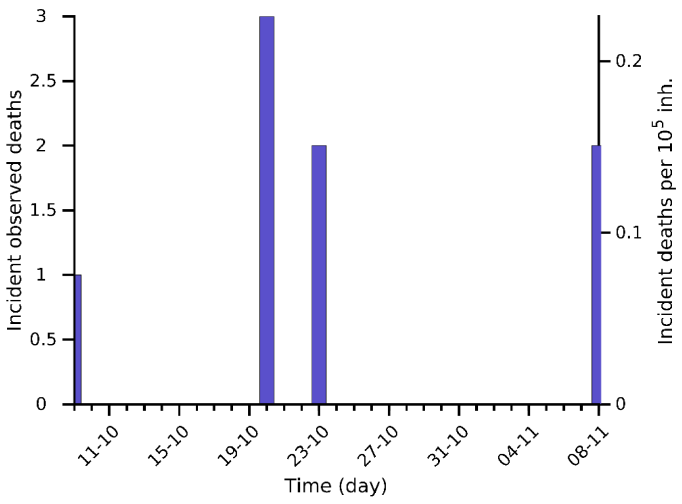
	A14	EPG	CFR	N7	D7
Today	129	216	0.42 %	163	0
A Week ago	68	108	0.75 %	82	0
Maximum	129	216	4.92 %	163	3

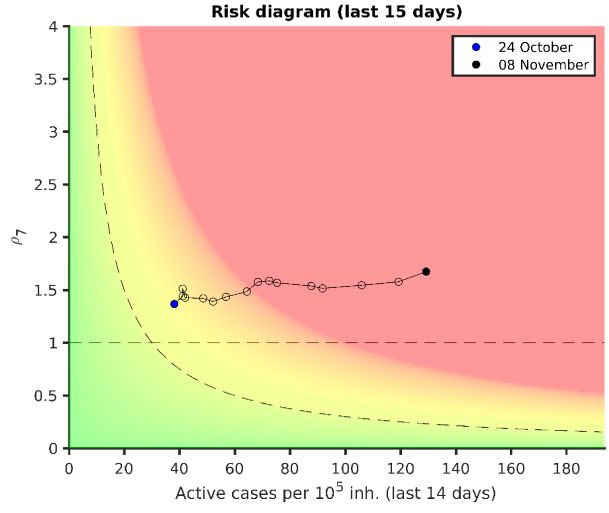




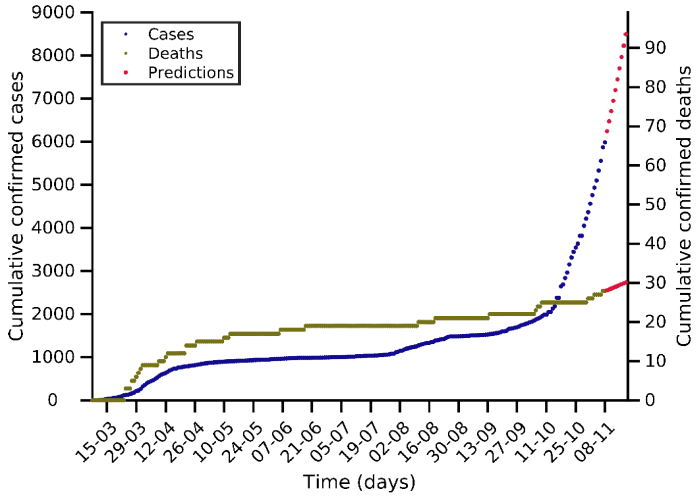








Cyprus 08-11-2020. Pop: 1.2M. Cumulative incidence: 496/10^5

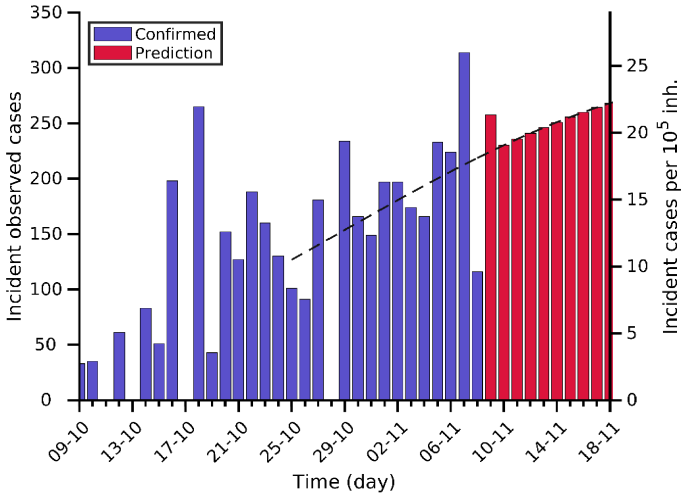


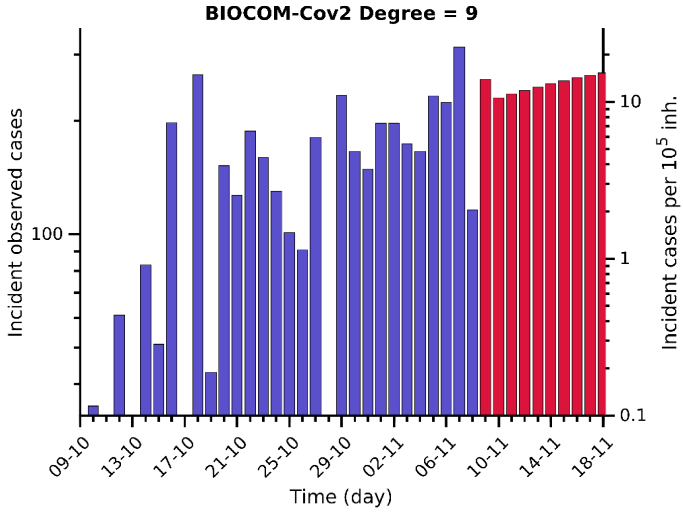
Predictions for next days

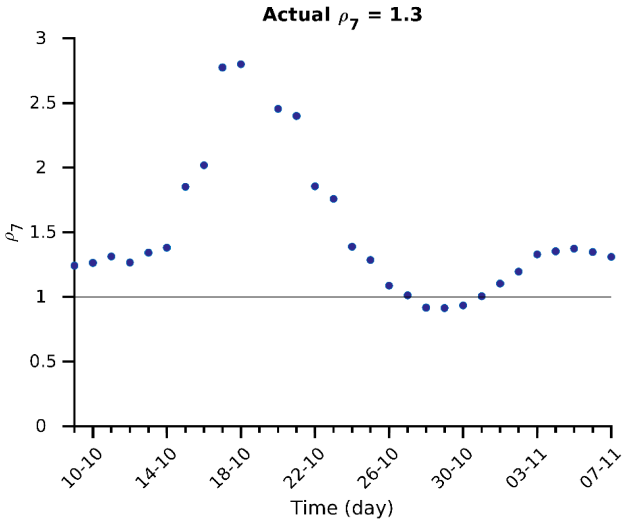
Day	Number of cases	95% Confidence Interval
11-11-2020	6711 (+724)	[5987 - 7636]
15-11-2020	7705 (+1718)	[5987 - 9998]
18-11-2020	8497 (+2510)	[5987 - 13023]

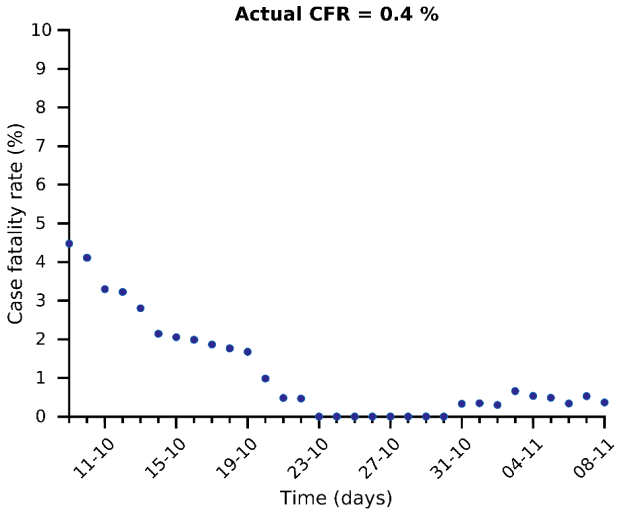
Current indicators

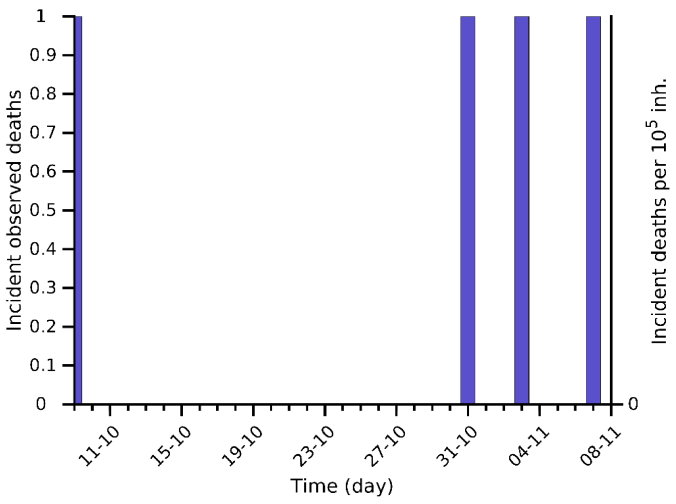
	A14	EPG	CFR	N7	D7
Today	202	265	0.37 %	203	0
A Week ago	159	160	0.34 %	145	0
Maximum	202	271	4.48 %	215	1

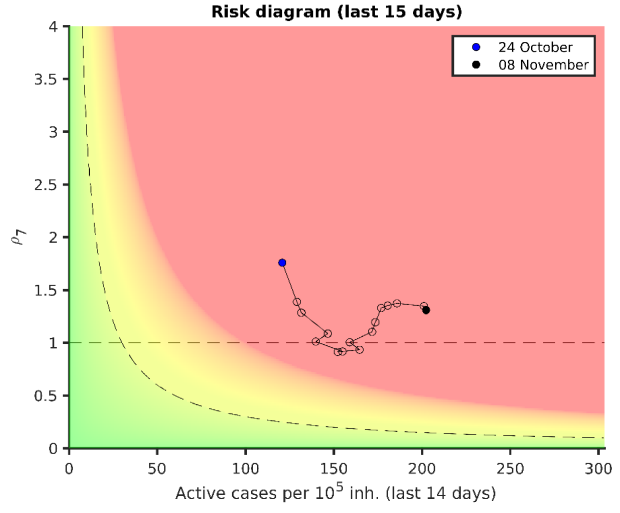




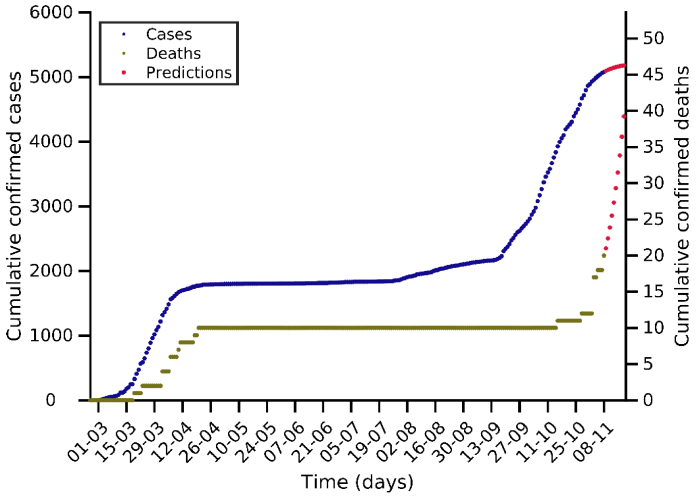








Iceland 08-11-2020. Pop: 0.3M. Cumulative incidence: 1488/10^5

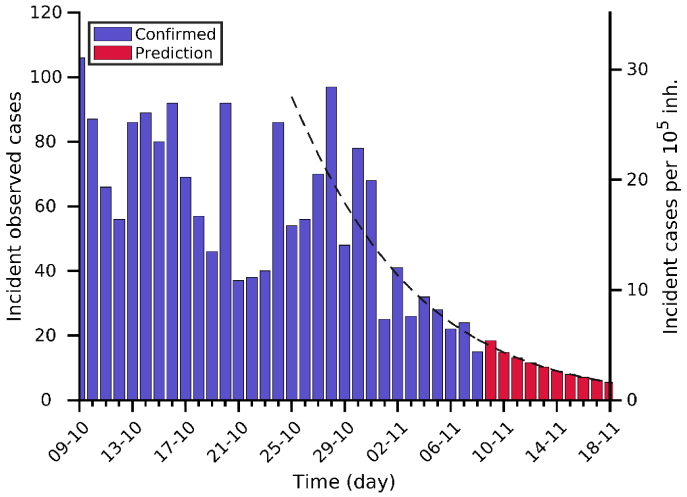


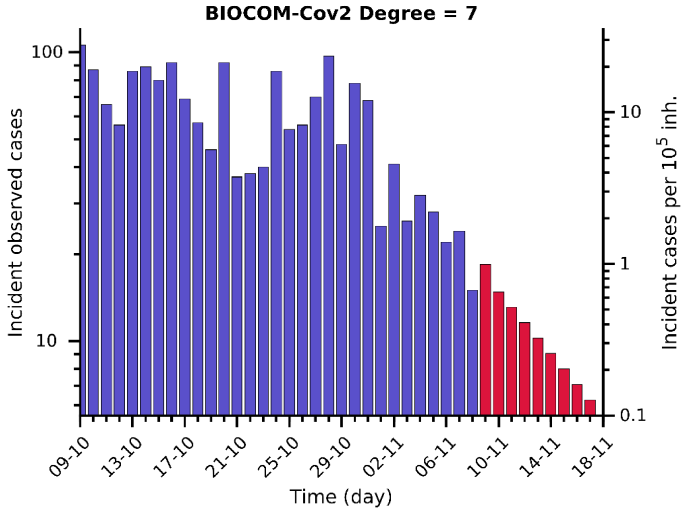
Predictions for next days

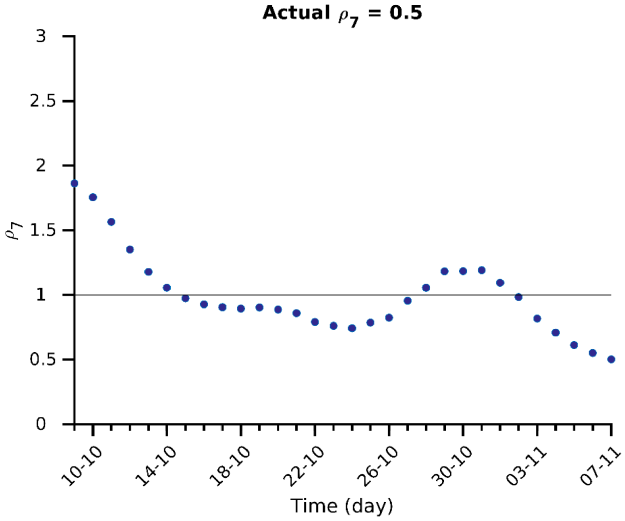
Day	Number of cases	95% Confidence Interval
11-11-2020	5124 (+46)	[5078 - 5182]
15-11-2020	5163 (+85)	[5095 - 5232]
18-11-2020	5182 (+104)	[5103 - 5261]

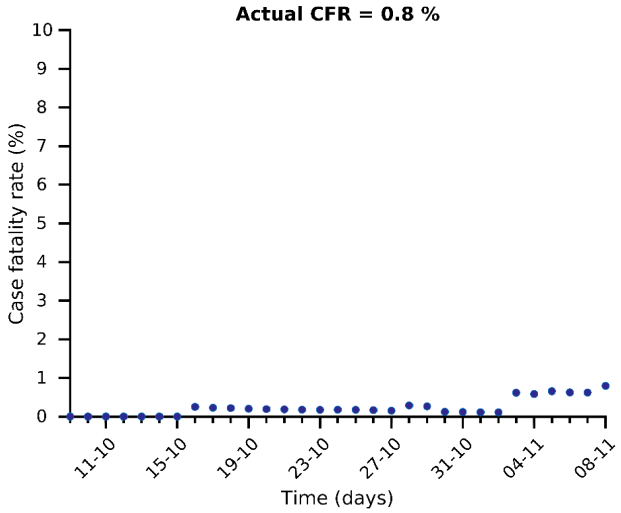
Current indicators

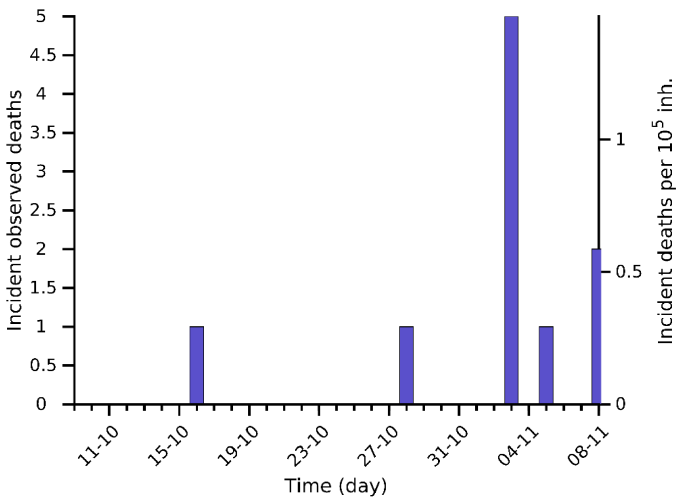
	A14	EPG	CFR	N7	D7
Today	185	93	0.79 %	27	1
A Week ago	245	291	0.11 %	63	0
Maximum	332	469	4.65 %	86	1

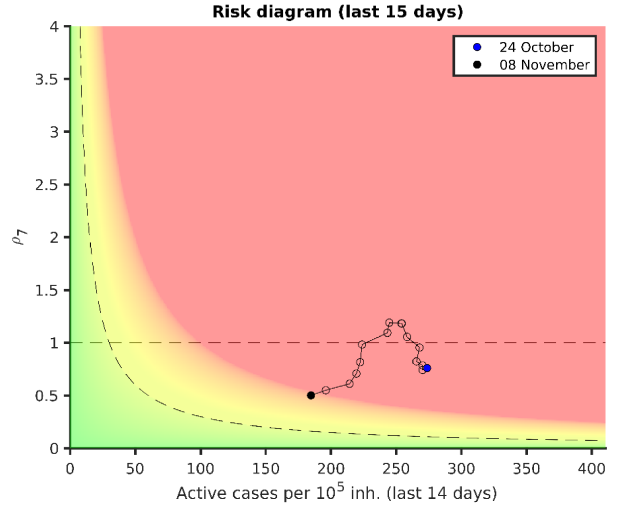






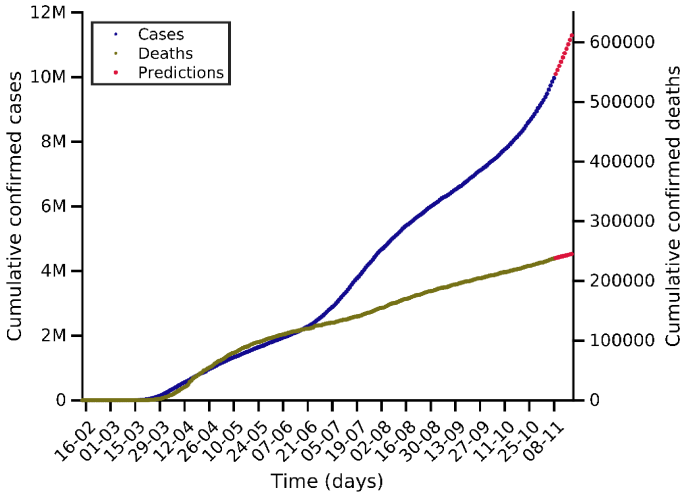






(2) Analysis and prediction of COVID-19 for other countries

USA 08-11-2020. Pop: 331.0M. Cumulative incidence: 3013/10^5

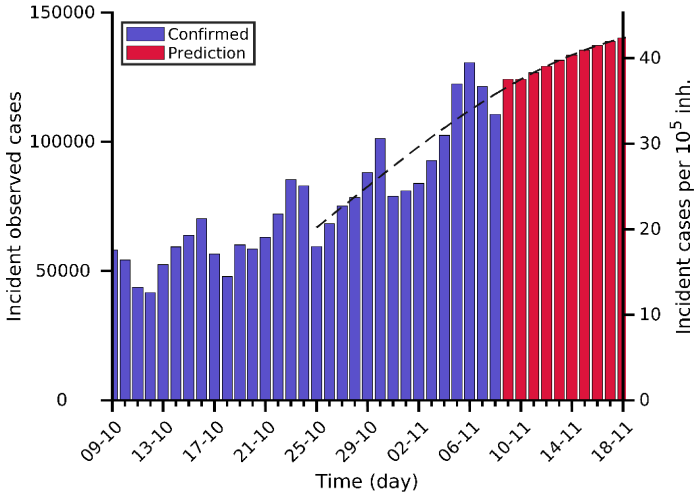


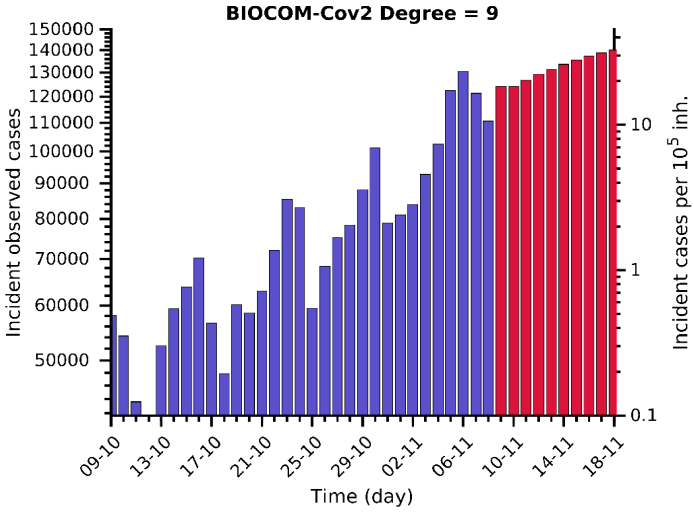
Predictions for next days

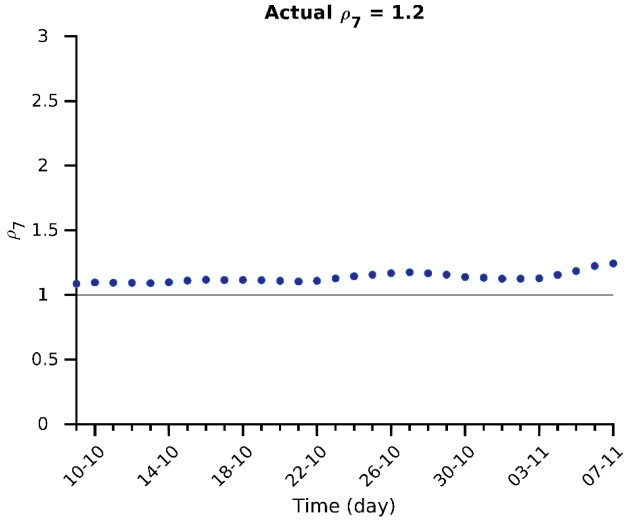
Day	Number of cases	95% Confidence Interval
11-11-2020	10346793 (+375142)	[10260167 - 10433420]
15-11-2020	10876579 (+904928)	[10667766 - 11085391]
18-11-2020	11292776 (+1321125)	[10888086 - 11697467]

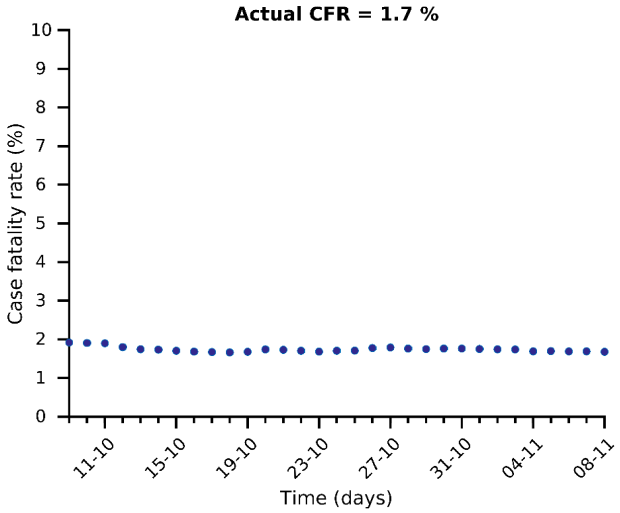
Current indicators

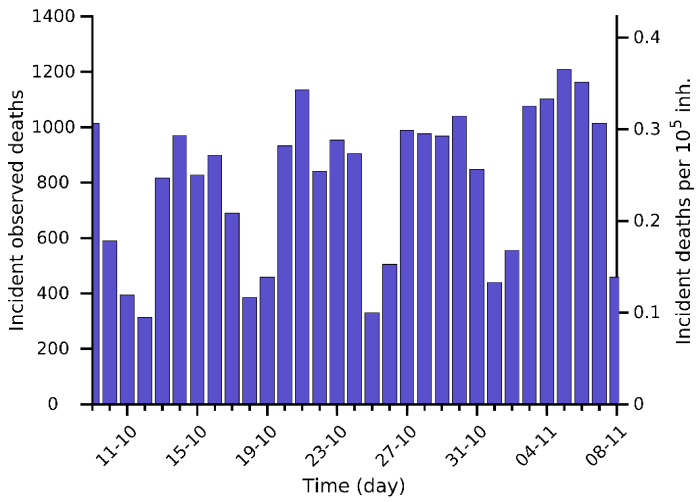
	A14	EPG	CFR	N7	D7
Today	403	502	1.68 %	109184	939
A Week ago	318	360	1.75 %	81600	824
Maximum	403	502	5.00 %	109184	2715

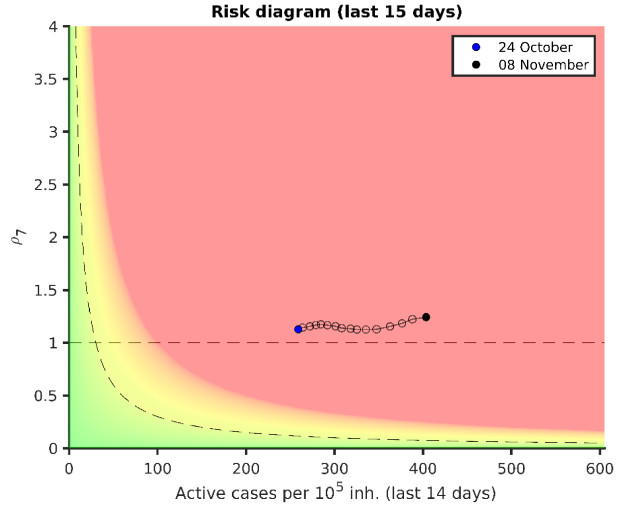




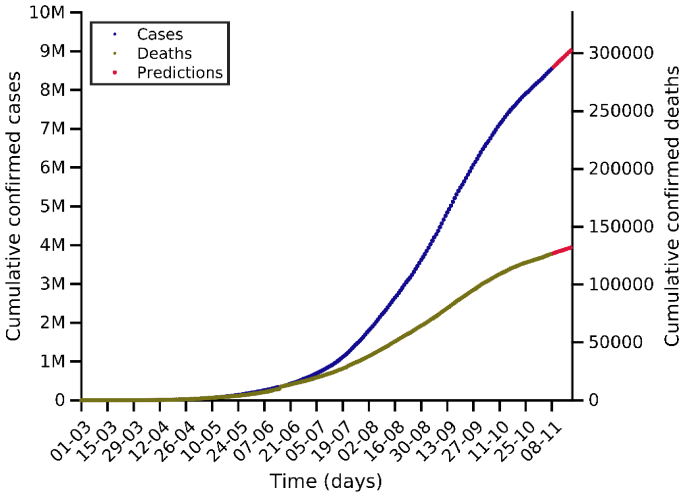








India 08-11-2020. Pop: 1353.0M. Cumulative incidence: 632/10⁵

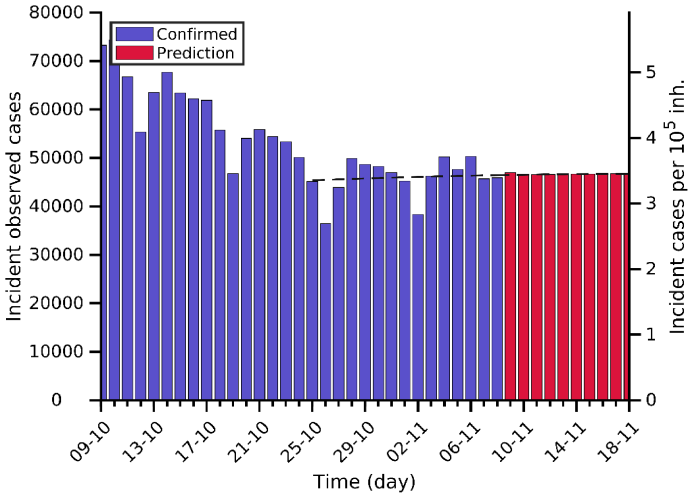


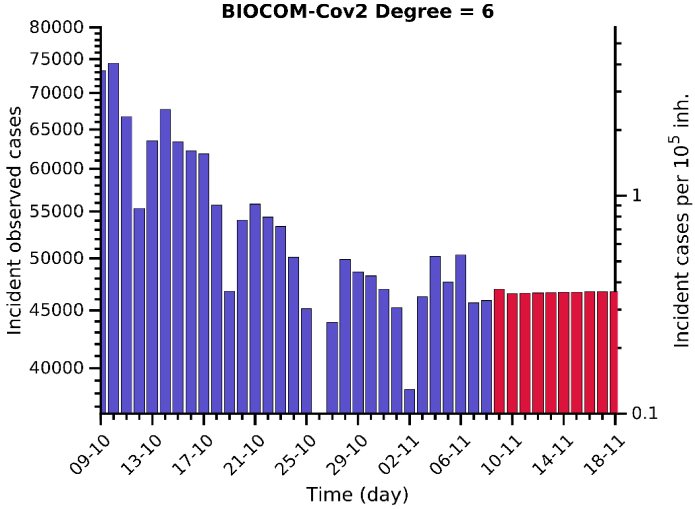
Predictions for next days

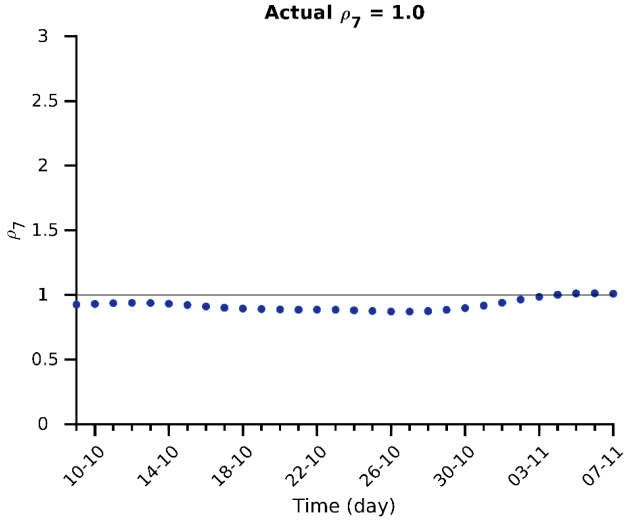
Day	Number of cases	95% Confidence Interval
11-11-2020	8693749 (+140092)	[8670112 - 8717386]
15-11-2020	8880378 (+326721)	[8827794 - 8932961]
18-11-2020	9020571 (+466914)	[8921015 - 9120128]

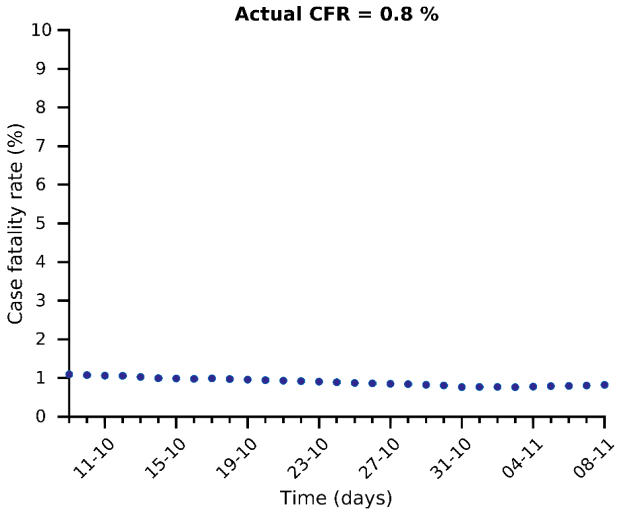
Current indicators

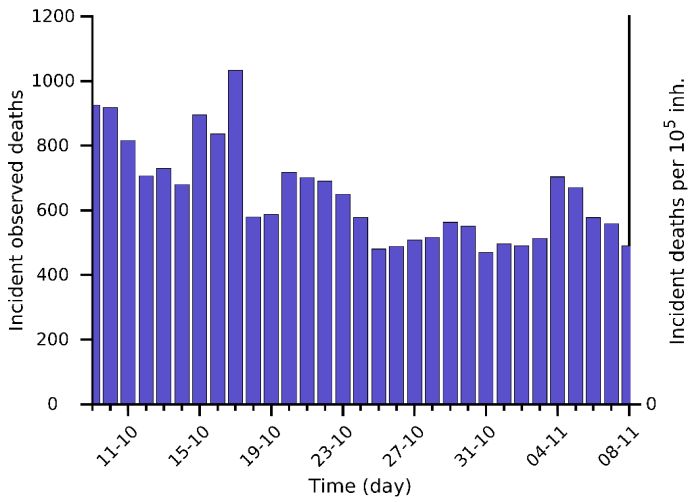
	A14	EPG	CFR	N7	D7
Today	48	48	0.82 %	46335	572
A Week ago	50	46	0.76 %	45622	513
Maximum	95	98	4.40 %	93199	1168

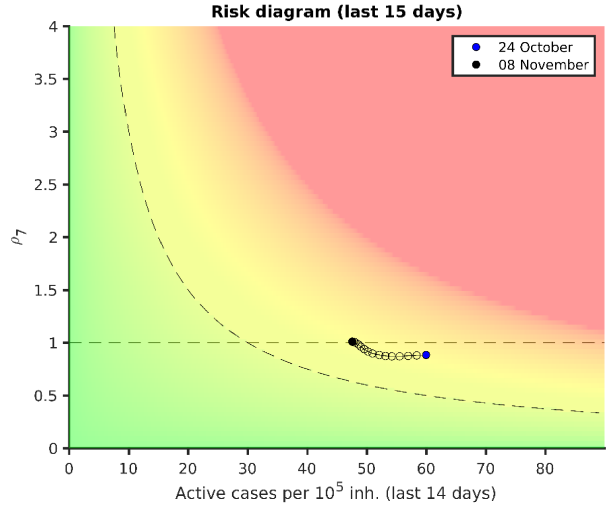




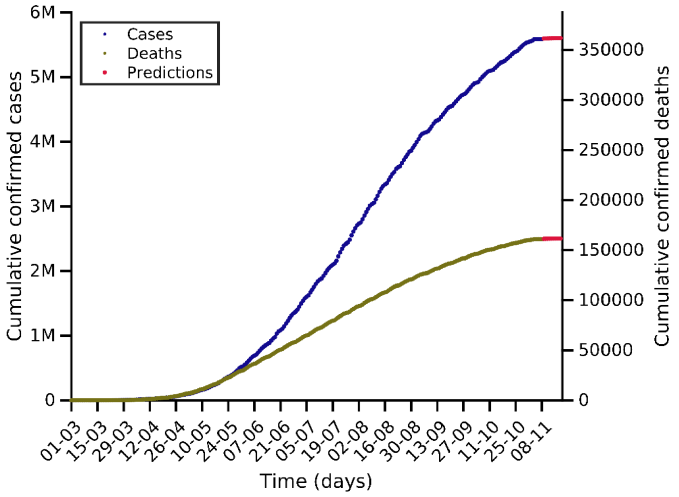








Brazil 08-11-2020. Pop: 212.6M. Cumulative incidence: 2630/10^5

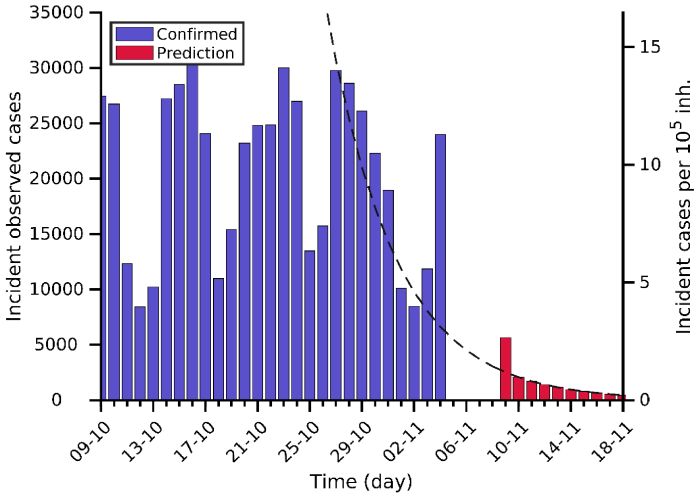


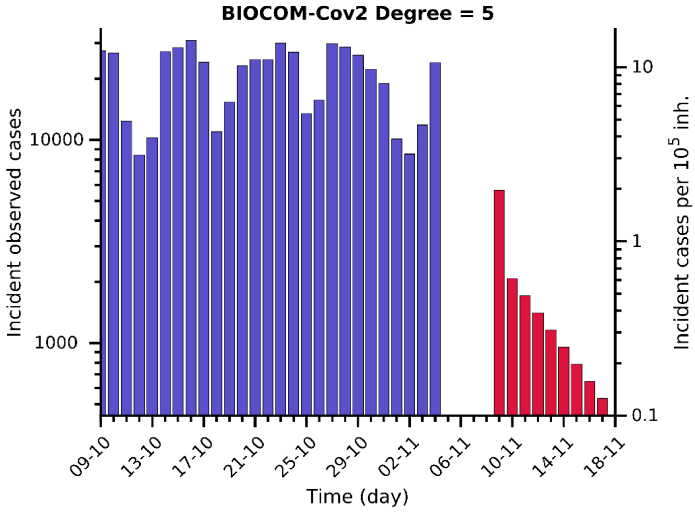
Predictions for next days

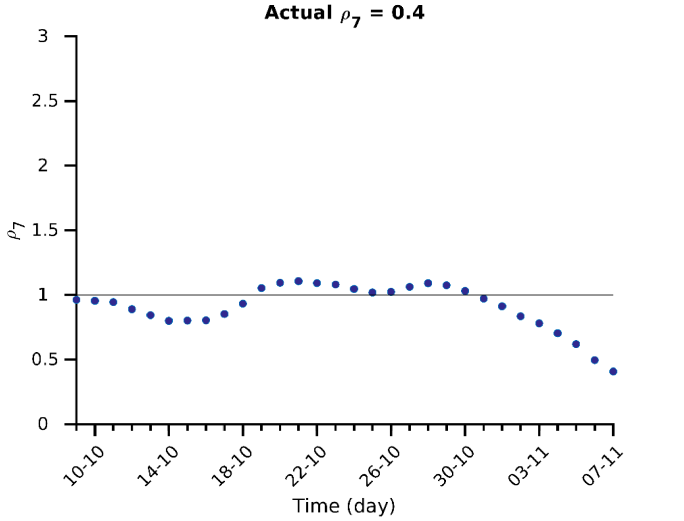
Day	Number of cases	95% Confidence Interval
11-11-2020	5599463 (+9438)	[5590025 - 5665529]
15-11-2020	5603773 (+13748)	[5590025 - 5670799]
18-11-2020	5605392 (+15367)	[5590025 - 5689128]

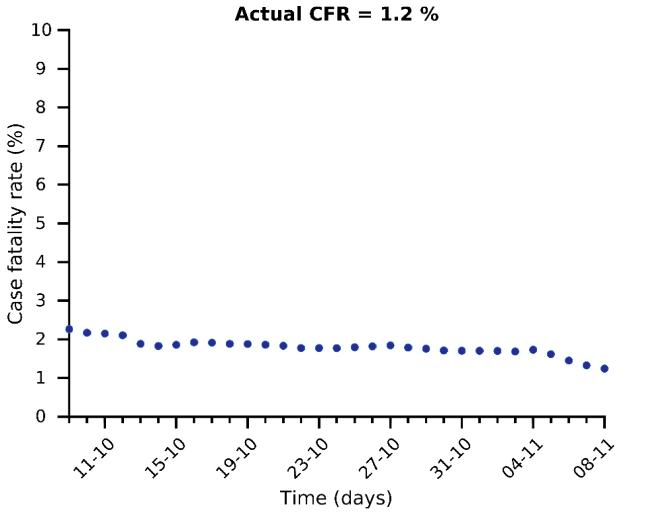
Current indicators

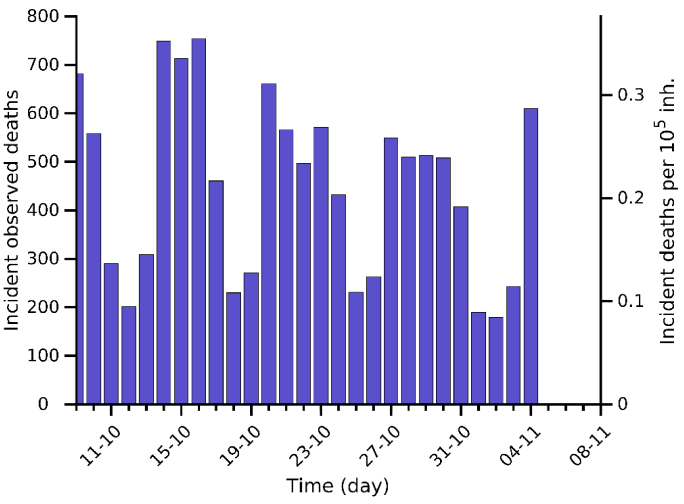
	A14	EPG	CFR	N7	D7
Today	92	38	1.24 %	6331	147
A Week ago	146	142	1.70 %	21654	420
Maximum	302	349	4.84 %	46393	1097

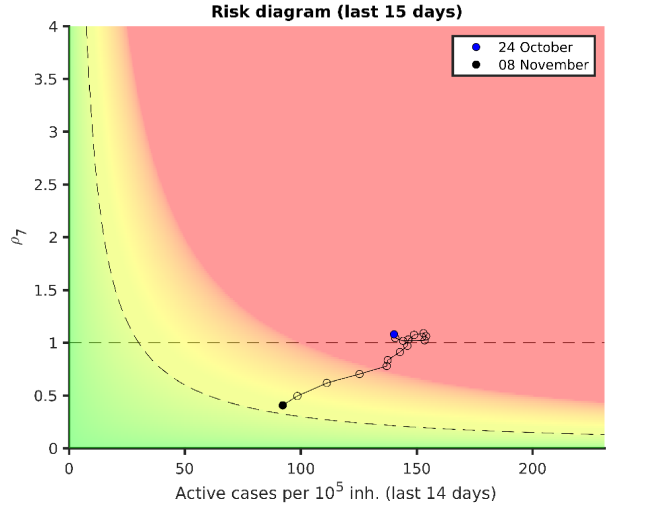




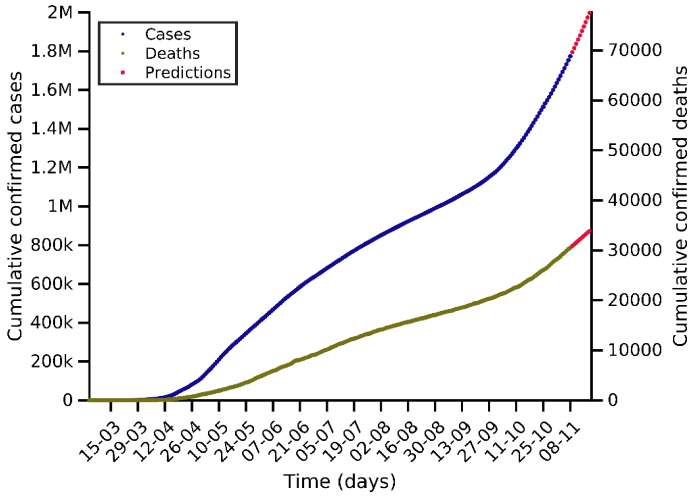








Russia 08-11-2020. Pop: 145.9M. Cumulative incidence: 1216/10⁵

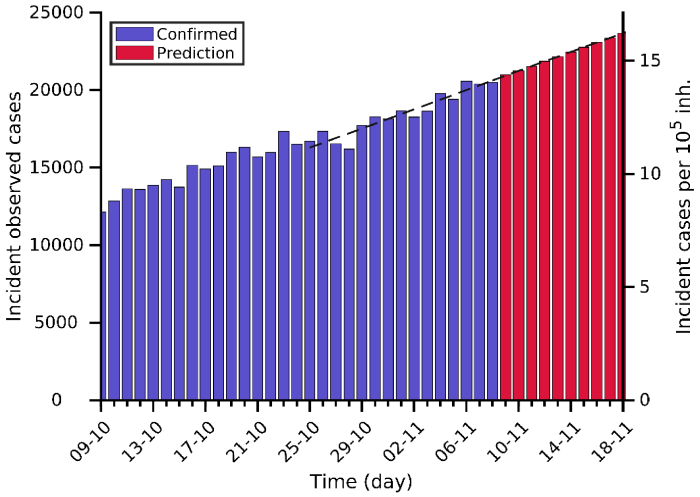


Predictions for next days

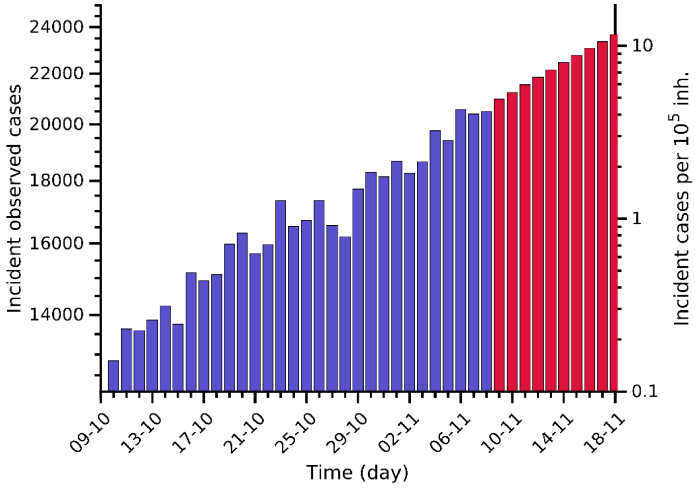
Day	Number of cases	95% Confidence Interval
11-11-2020	1838096 (+63762)	[1836225 - 1839966]
15-11-2020	1927335 (+153001)	[1922815 - 1931855]
18-11-2020	1997441 (+223107)	[1988513 - 2006370]

Current indicators

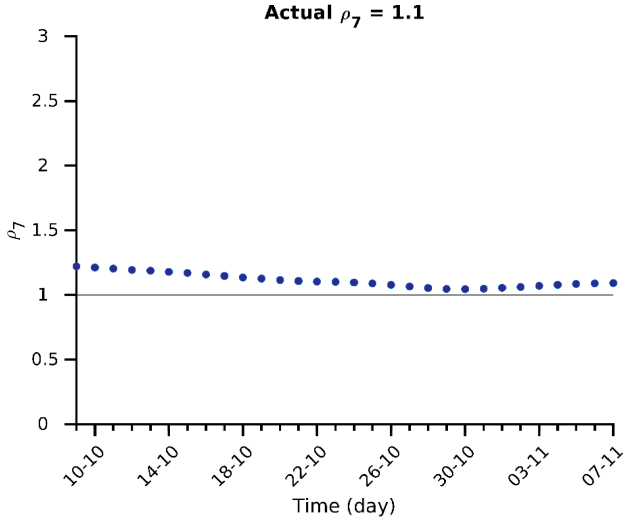
	A14	EPG	CFR	N7	D7
Today	178	195	2.43 %	19650	329
A Week ago	163	170	2.75 %	17558	312
Maximum	178	195	4.72 %	19650	329



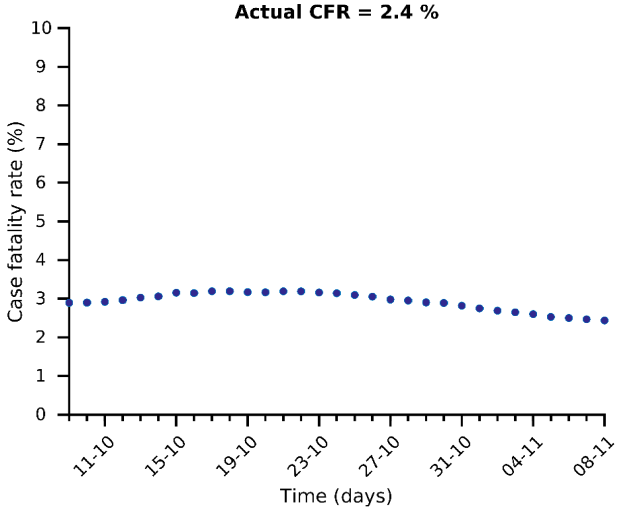
BIOCOM-Cov2 Degree = 8

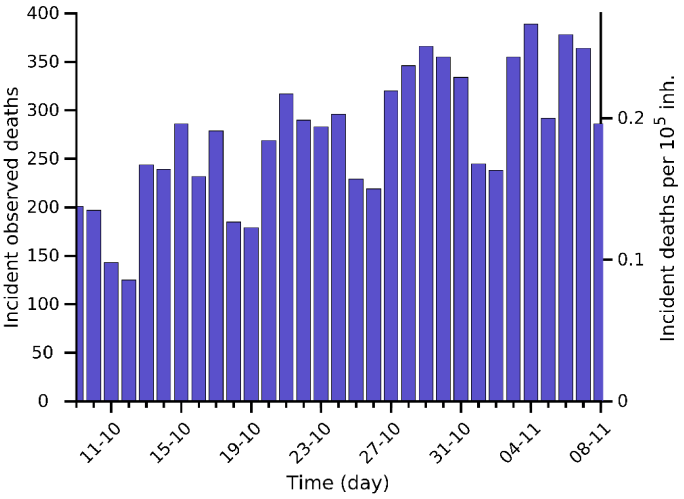


Actual ρ_7 = 1.1

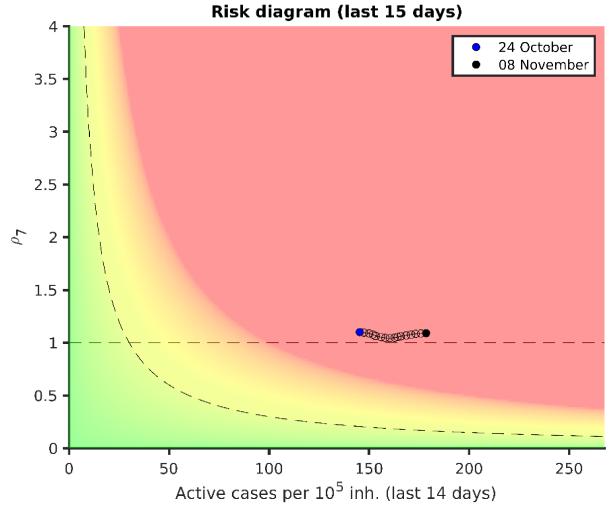


Actual CFR = 2.4 %

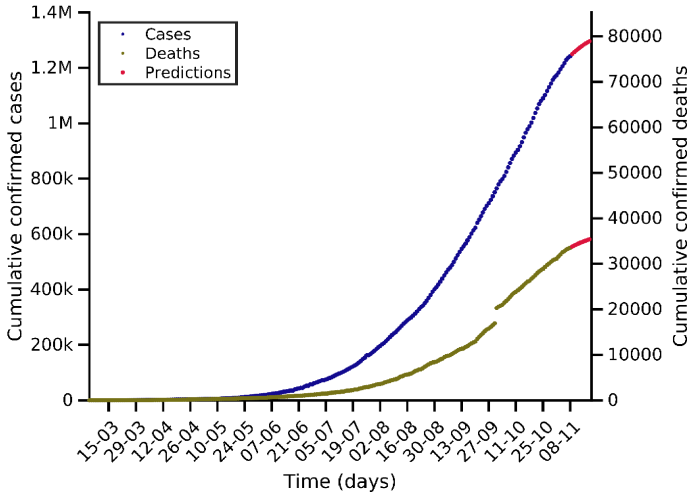




Risk diagram (last 15 days)



Argentina 08-11-2020. Pop: 45.2M. Cumulative incidence: 2748/10⁵

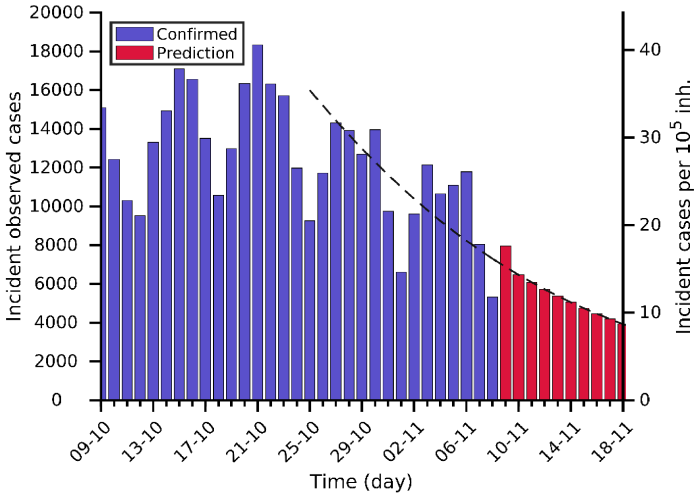


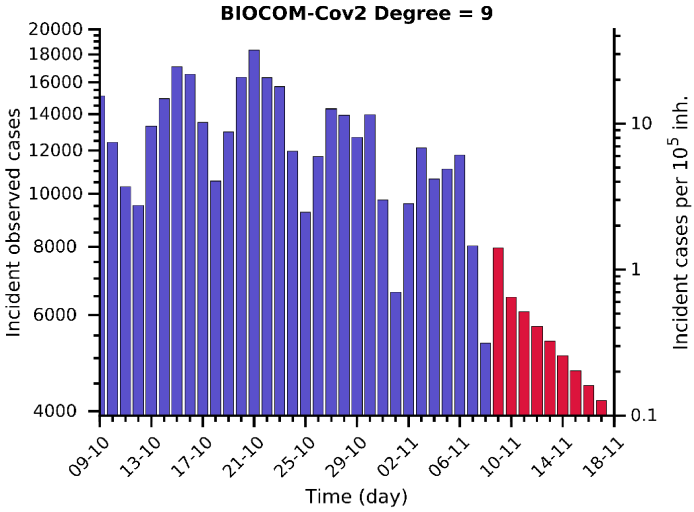
Predictions for next days

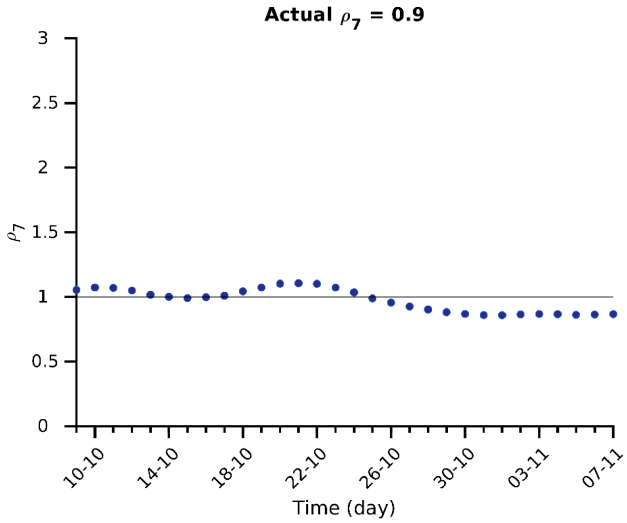
Day	Number of cases	95% Confidence Interval
11-11-2020	1262682 (+20513)	[1242169 - 1284975]
15-11-2020	1283576 (+41407)	[1250919 - 1316232]
18-11-2020	1296145 (+53976)	[1249631 - 1342659]

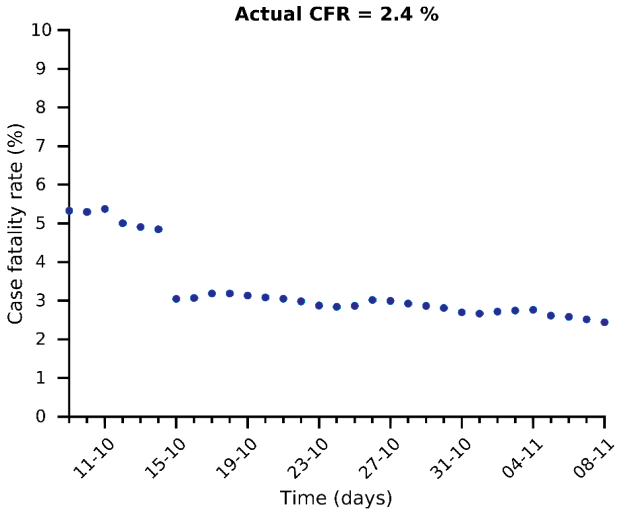
Current indicators

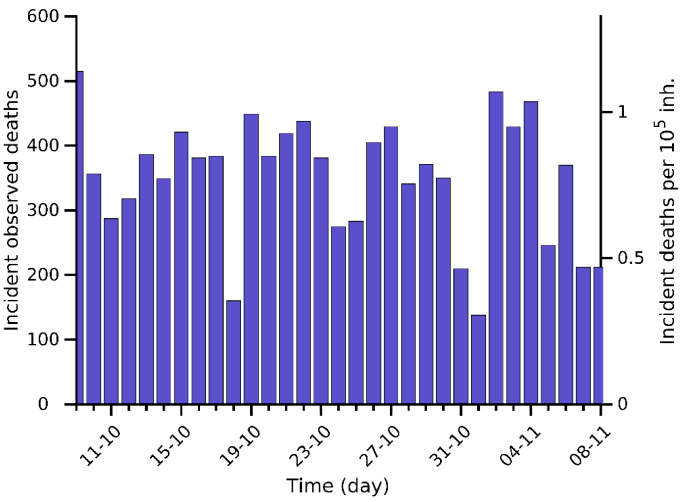
	A14	EPG	CFR	N7	D7
Today	335	291	2.44 %	9807	346
A Week ago	407	350	2.66 %	11849	321
Maximum	442	483	4.91 %	15051	789

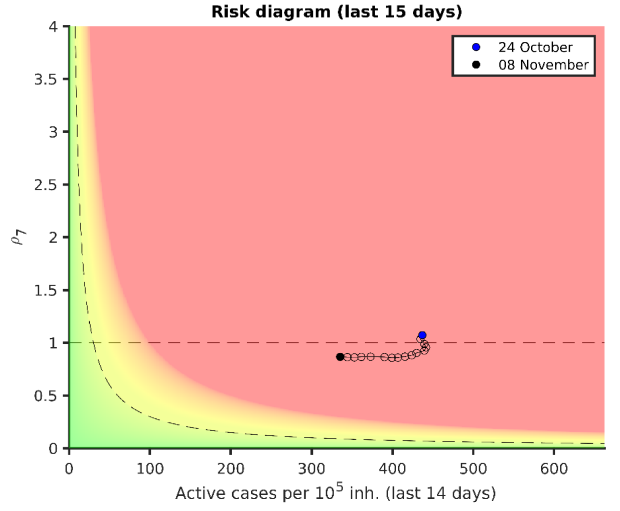




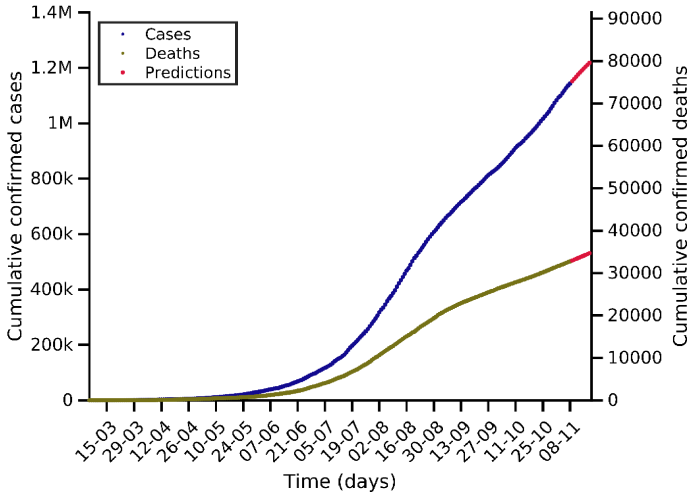








Colombia 08-11-2020. Pop: 50.9M. Cumulative incidence: 2248/10⁵

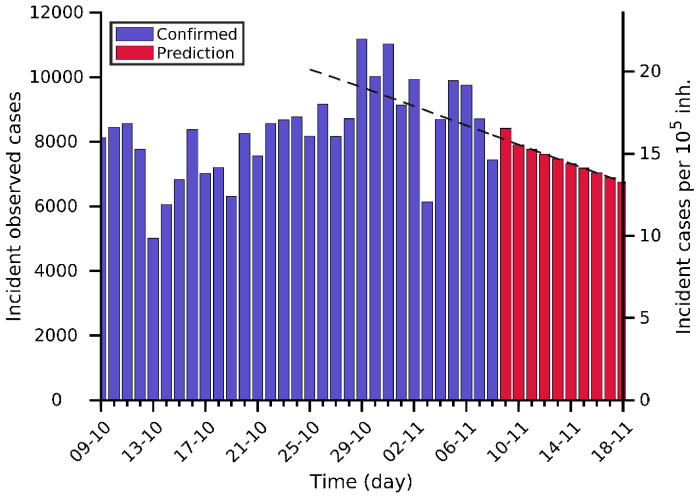


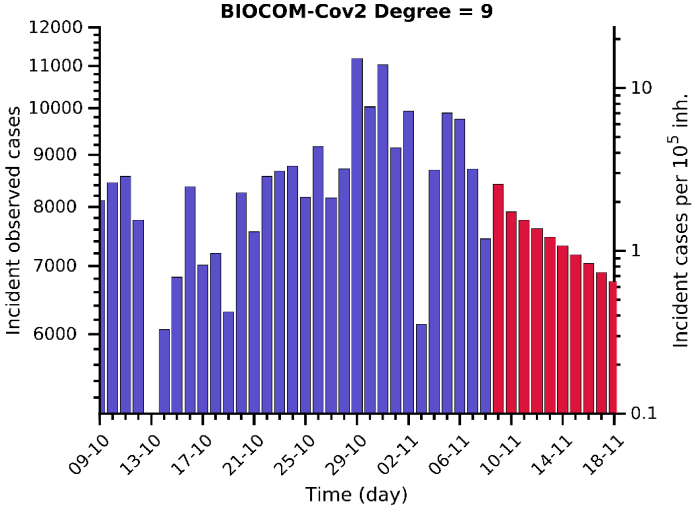
Predictions for next days

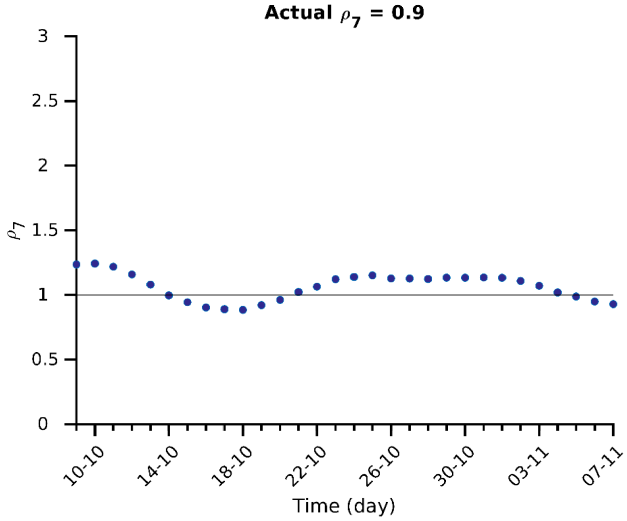
Day	Number of cases	95% Confidence Interval
11-11-2020	1167981 (+24094)	[1159241 - 1176721]
15-11-2020	1197573 (+53686)	[1181004 - 1214142]
18-11-2020	1218261 (+74374)	[1189768 - 1246754]

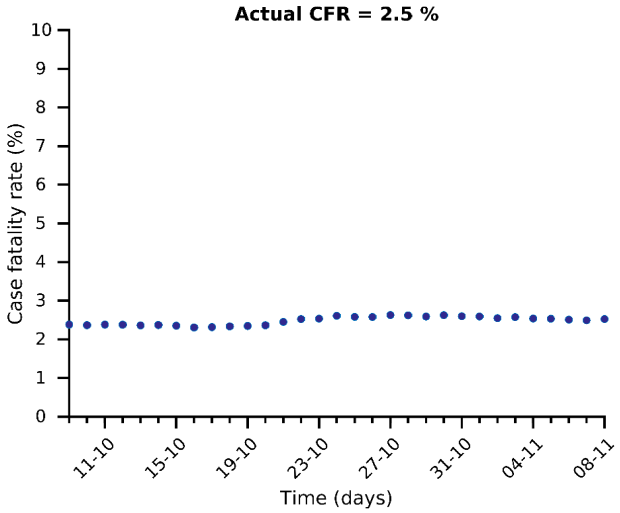
Current indicators

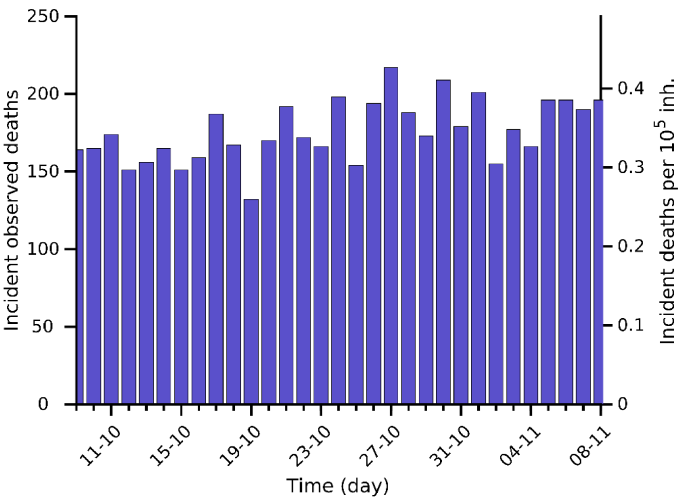
	A14	EPG	CFR	N7	D7
Today	252	234	2.52 %	8652	182
A Week ago	243	276	2.59 %	9634	194
Maximum	307	329	4.88 %	11550	326

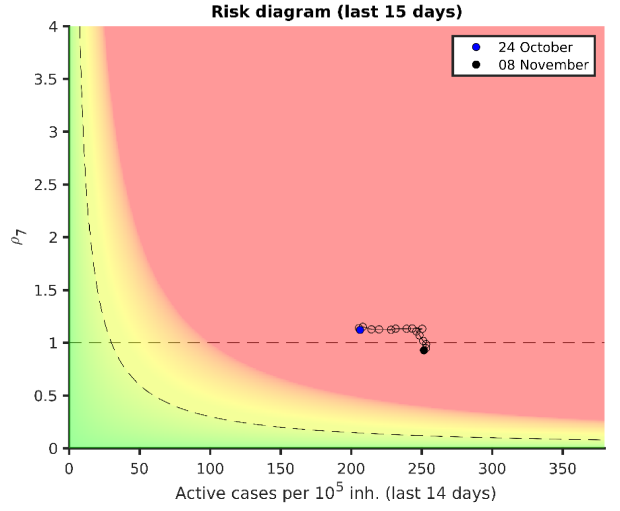




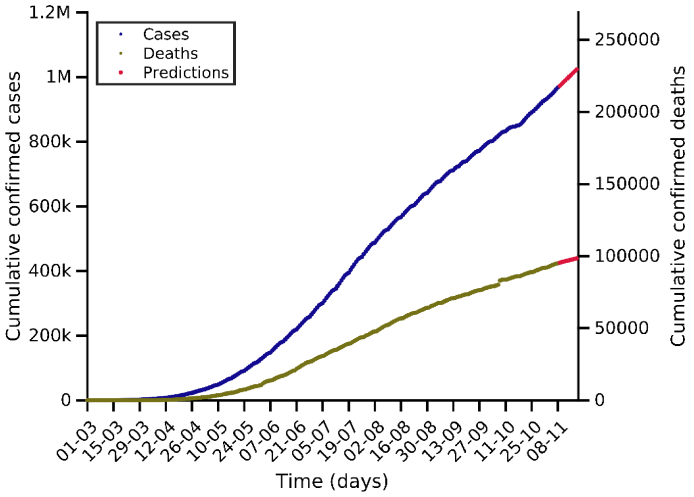








Mexico 08-11-2020. Pop: 128.9M. Cumulative incidence: 751/10^5

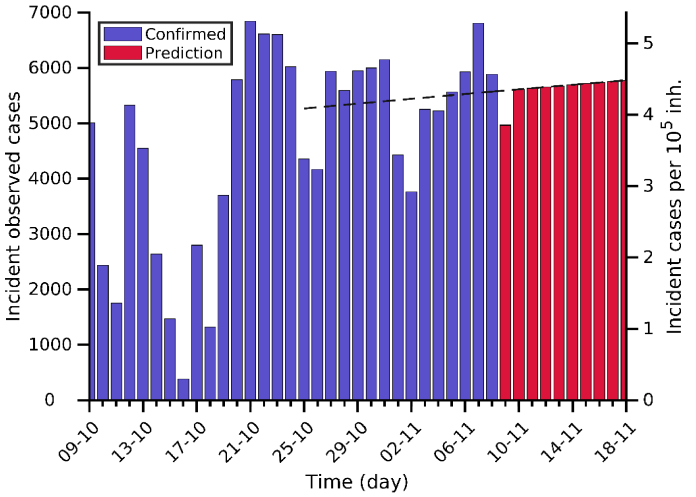


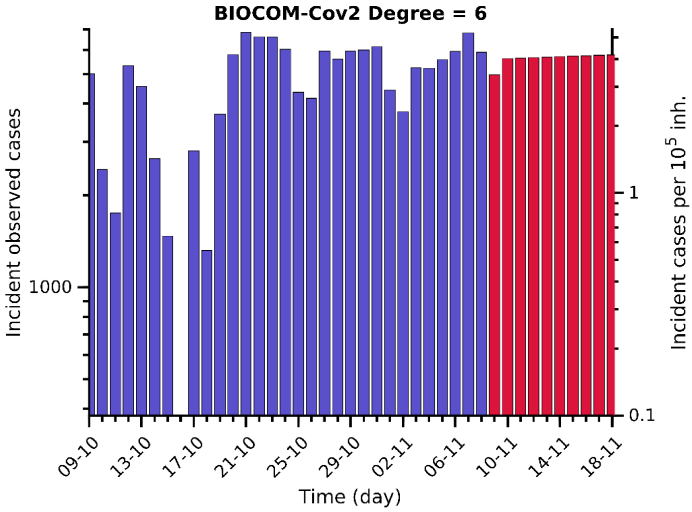
Predictions for next days

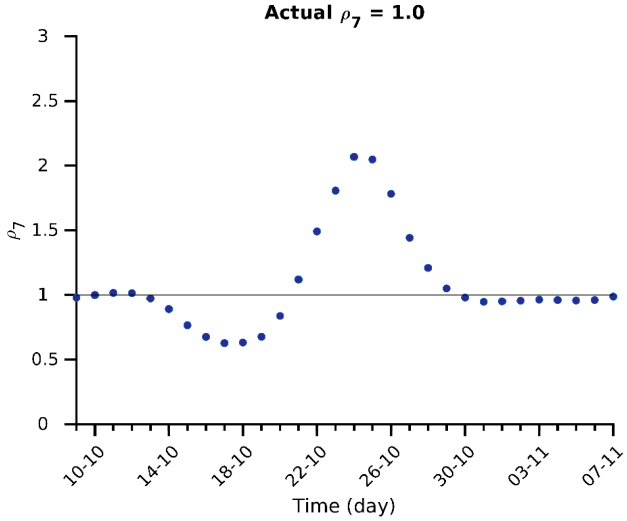
Day	Number of cases	95% Confidence Interval
11-11-2020	984040 (+16215)	[971178 - 996901]
15-11-2020	1006784 (+38959)	[977262 - 1036306]
18-11-2020	1024056 (+56231)	[967825 - 1080933]

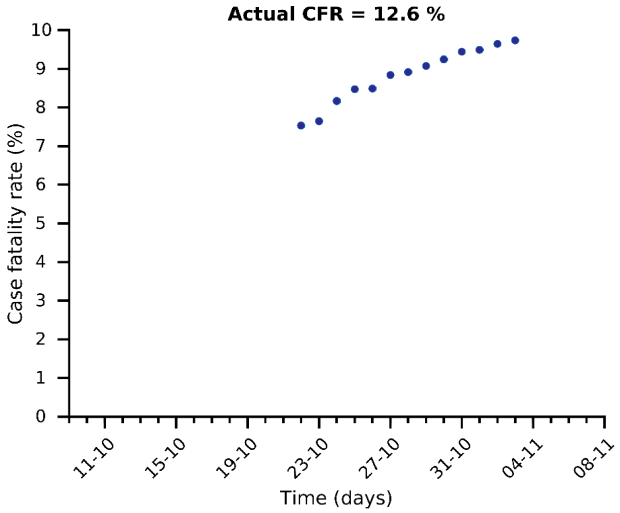
Current indicators

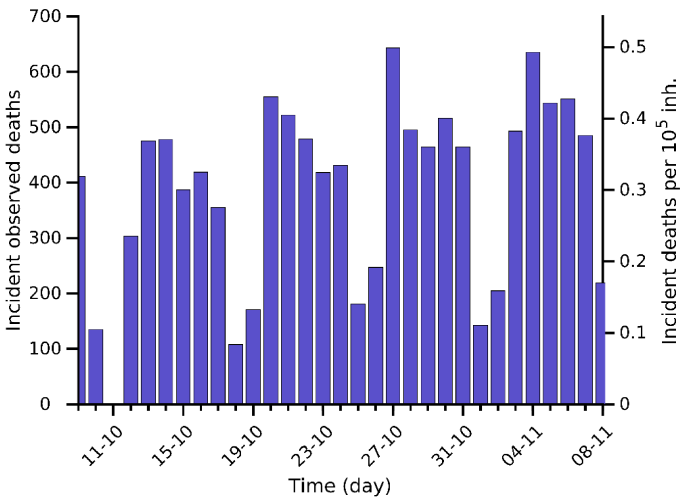
	A14	EPG	CFR	N7	D7
Today	59	59	10.00 %	5490	447
A Week ago	61	57	9.49 %	5462	424
Maximum	77	94	0.00 %	7171	800

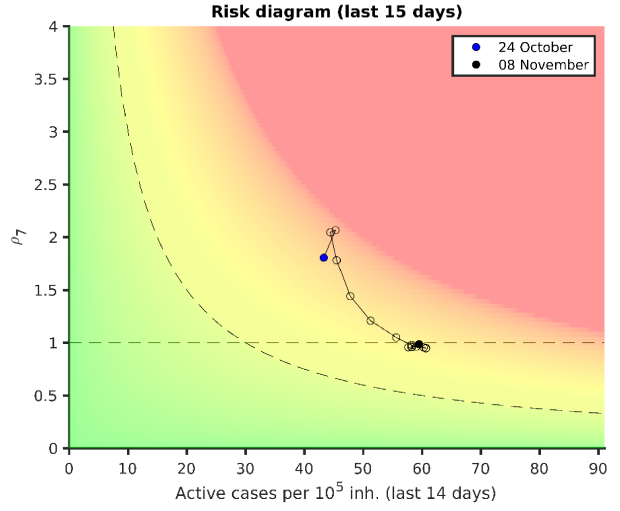




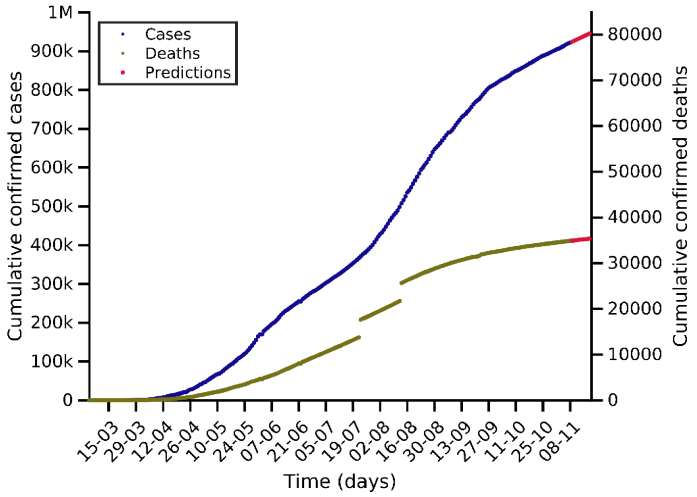








Peru 08-11-2020. Pop: 33.0M. Cumulative incidence: 2797/10⁵

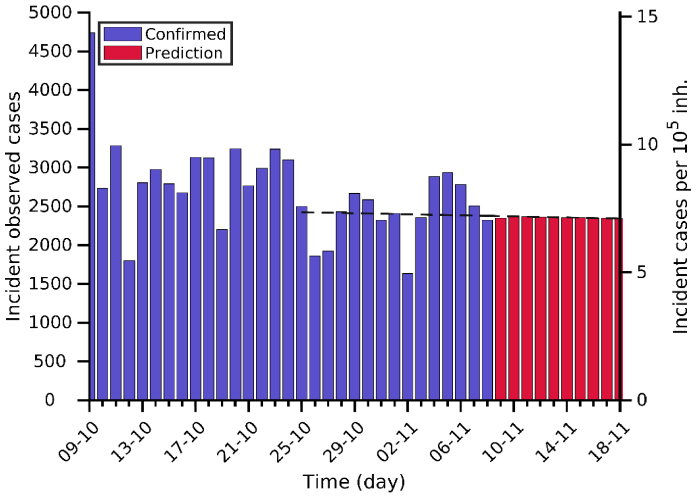


Predictions for next days

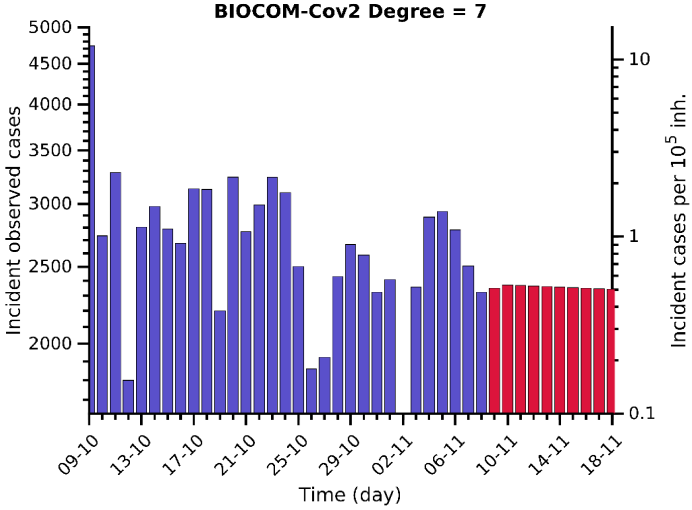
Day	Number of cases	95% Confidence Interval
11-11-2020	929423 (+7090)	[926136 - 932710]
15-11-2020	938860 (+16527)	[932879 - 944841]
18-11-2020	945900 (+23567)	[935415 - 956386]

Current indicators

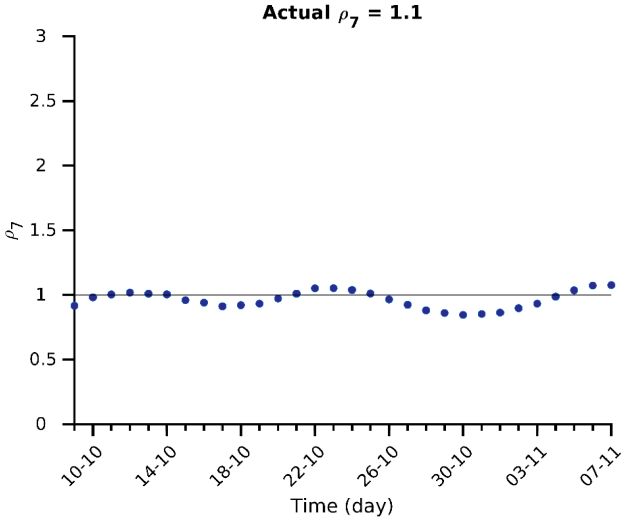
	A14	EPG	CFR	N7	D7
Today	102	110	1.80 %	2489	50
A Week ago	110	94	1.75 %	2314	54
Maximum	357	383	4.98 %	8552	747



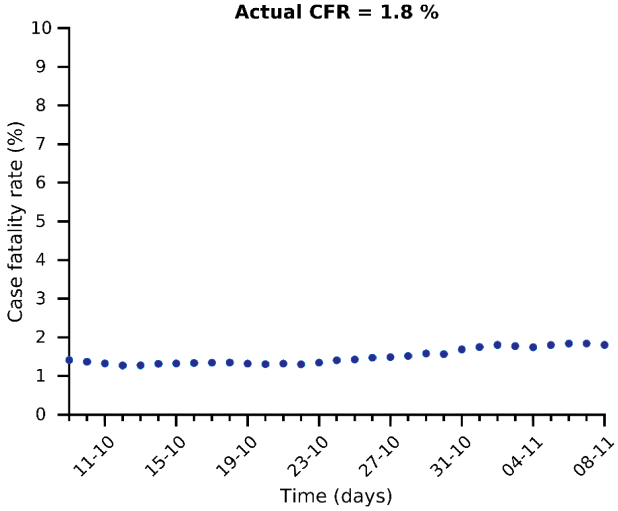
BIOCOM-Cov2 Degree = 7

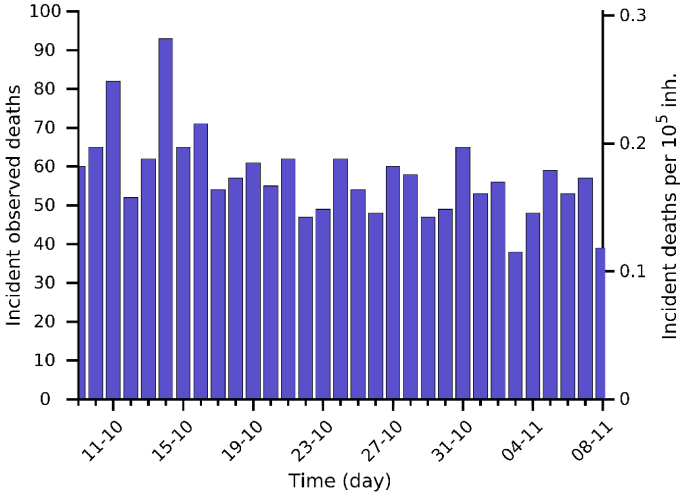


Actual ρ_7 = 1.1

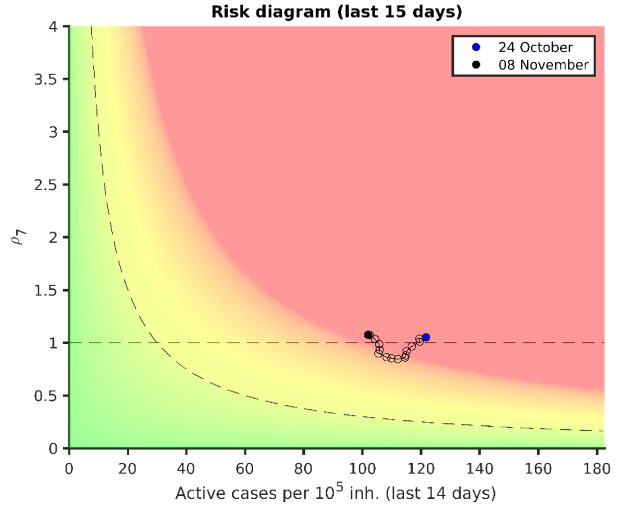


Actual CFR = 1.8 %

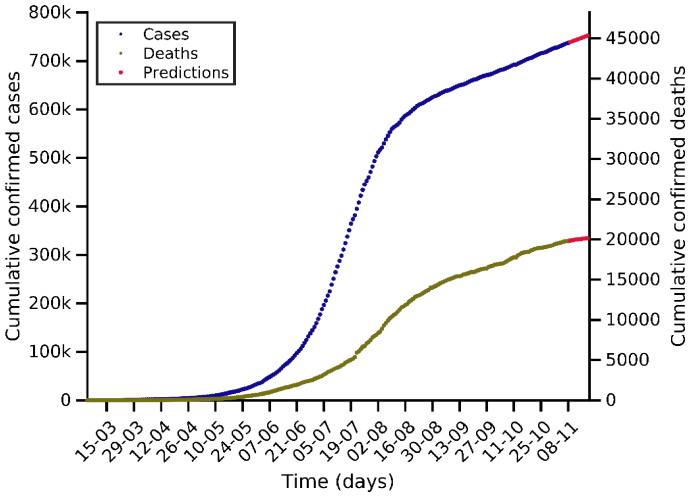




Risk diagram (last 15 days)



South Africa 08-11-2020. Pop: 59.3M. Cumulative incidence: 1243/10^5

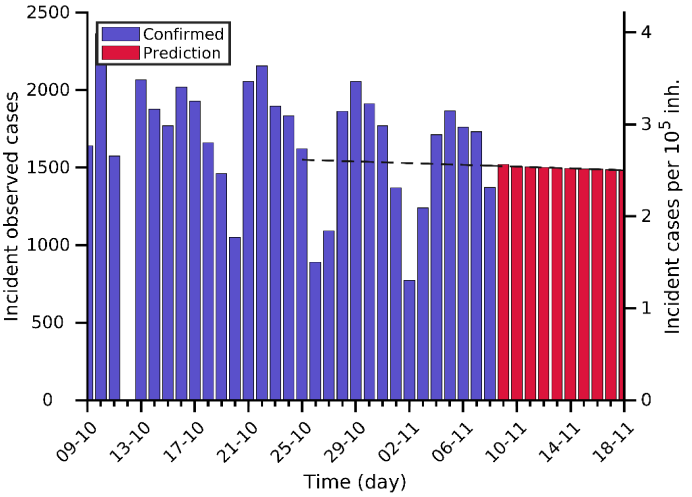


Predictions for next days

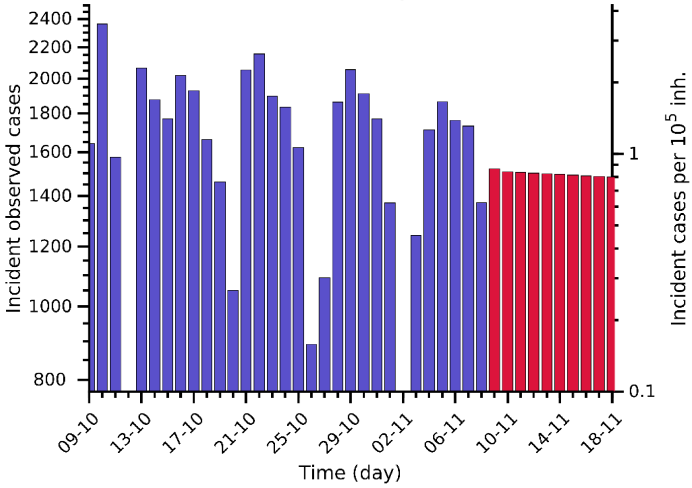
Day	Number of cases	95% Confidence Interval
11-11-2020	741809 (+4531)	[738936 - 744682]
15-11-2020	747794 (+10516)	[741537 - 754051]
18-11-2020	752253 (+14975)	[740417 - 764088]

Current indicators

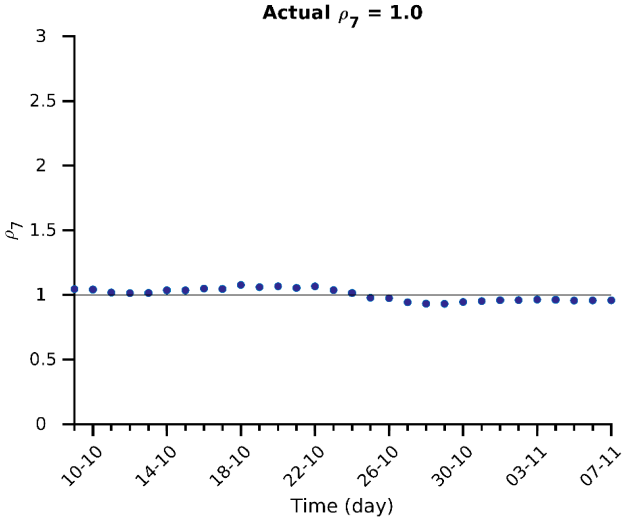
	A14	EPG	CFR	N7	D7
Today	36	35	3.74 %	1494	57
A Week ago	39	37	4.33 %	1565	63
Maximum	289	307	4.99 %	12584	297



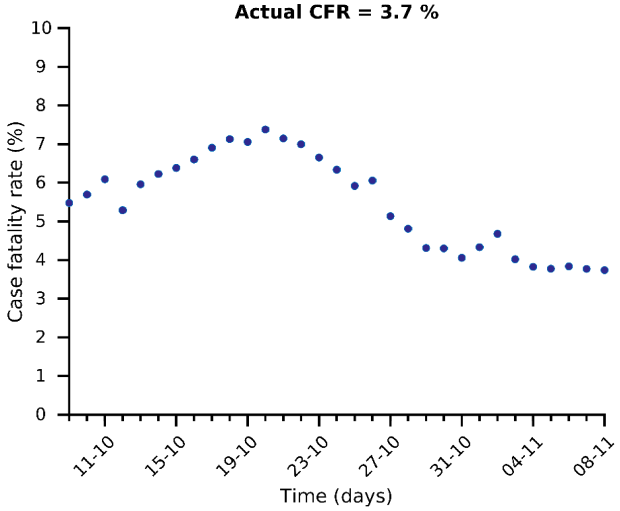
BIOCOM-Cov2 Degree = 5

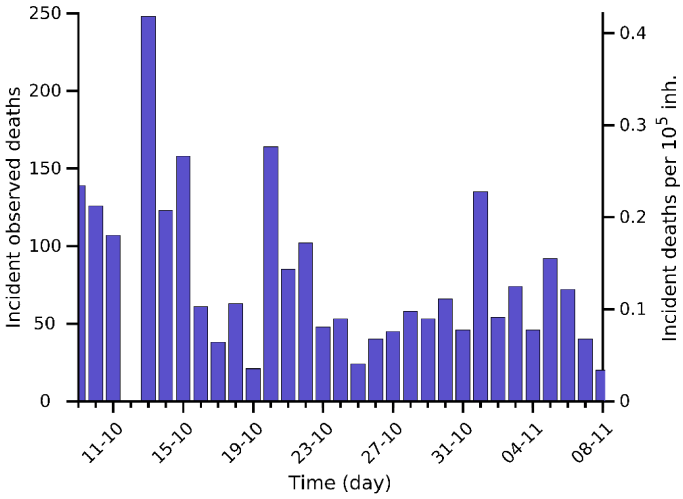


Actual ρ_7 = 1.0

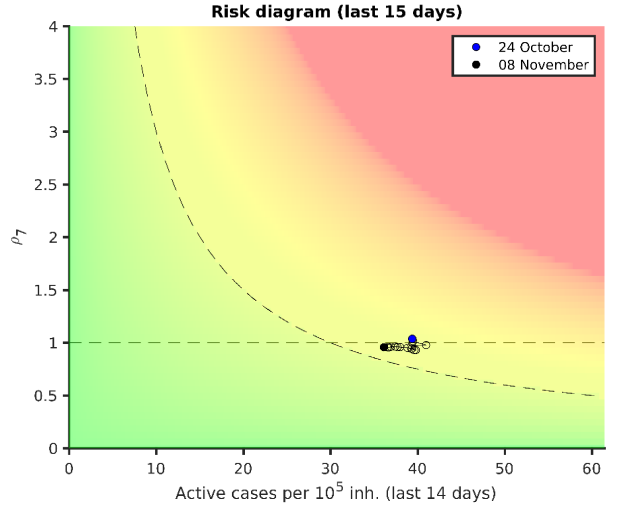


Actual CFR = 3.7 %

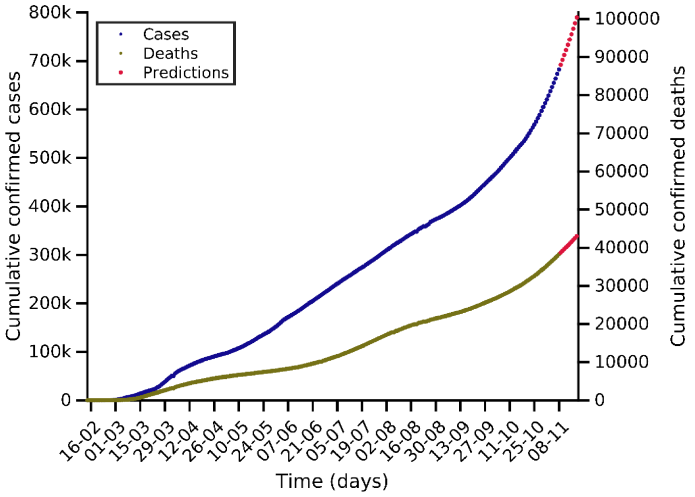




Risk diagram (last 15 days)



Iran 08-11-2020. Pop: 84.0M. Cumulative incidence: 813/10⁵

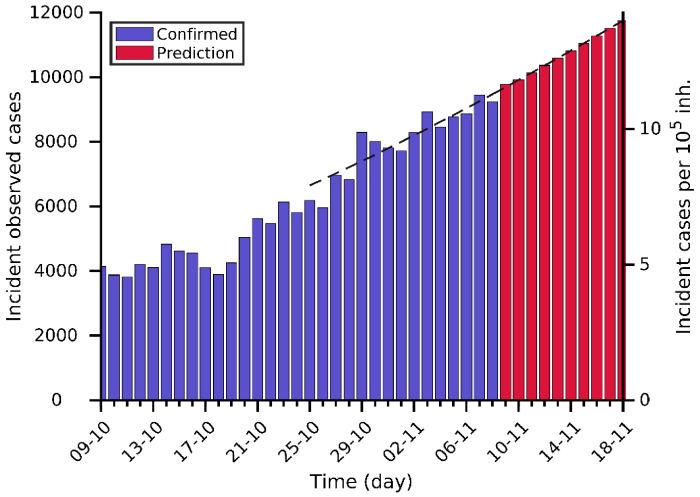


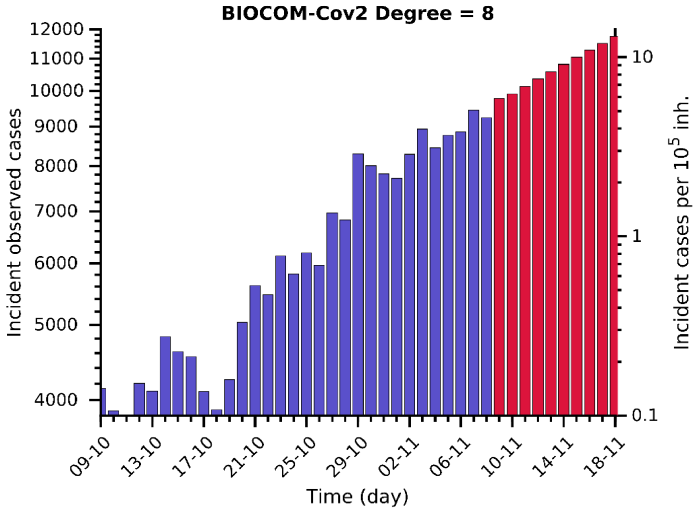
Predictions for next days

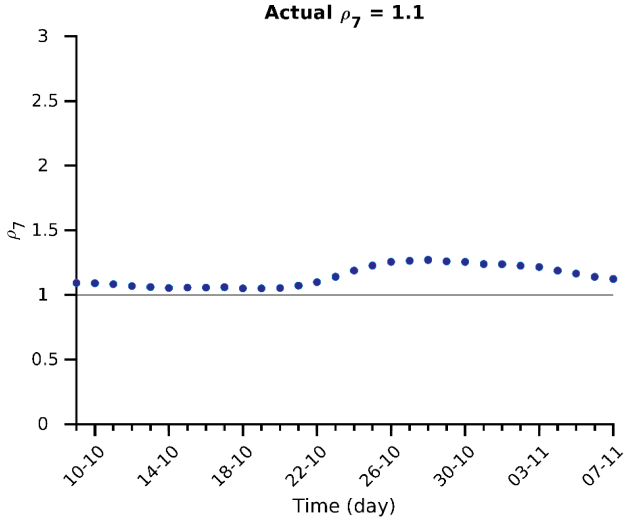
Day	Number of cases	95% Confidence Interval
11-11-2020	712312 (+29826)	[709480 - 715144]
15-11-2020	755131 (+72645)	[747901 - 762360]
18-11-2020	789682 (+107196)	[775005 - 804360]

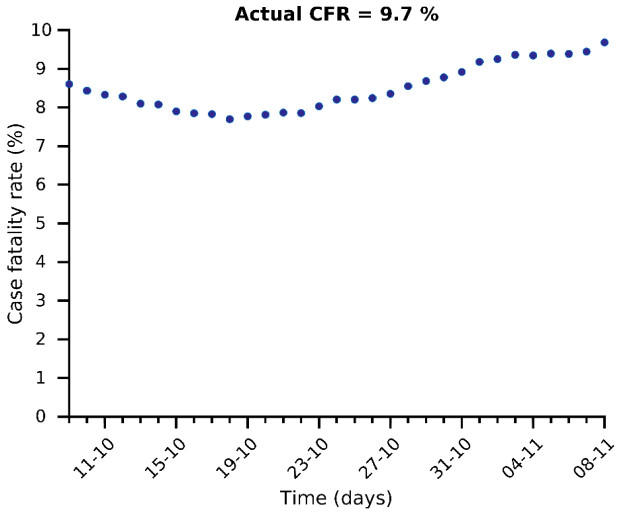
Current indicators

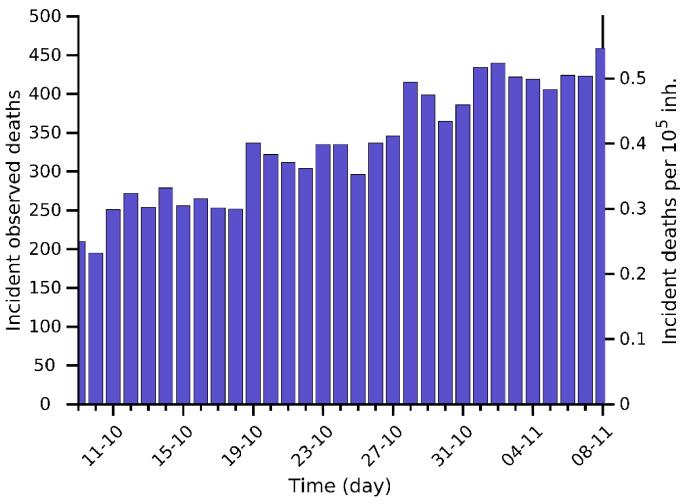
	A14	EPG	CFR	N7	D7
Today	135	152	9.68 %	8856	428
A Week ago	107	133	9.18 %	7371	383
Maximum	135	152	4.99 %	8856	428

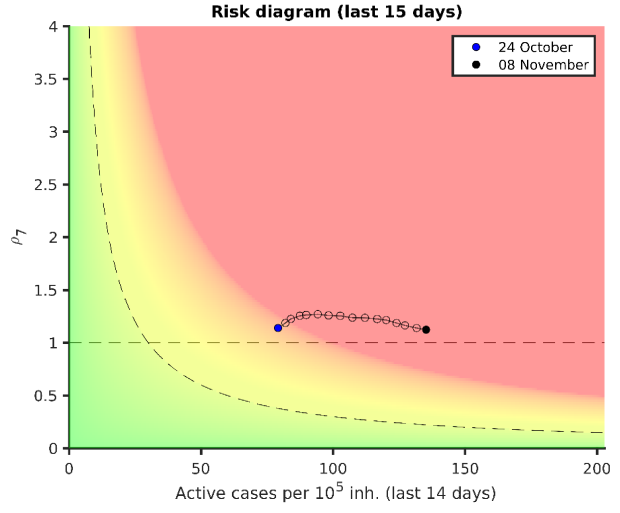




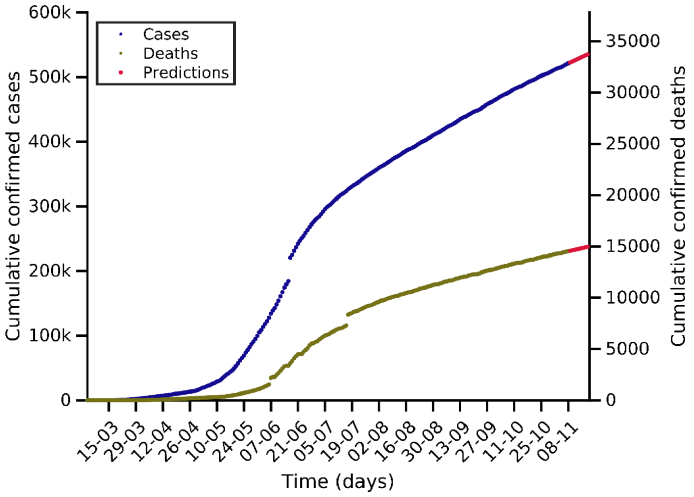








Chile 08-11-2020. Pop: 19.1M. Cumulative incidence: 2728/10^5

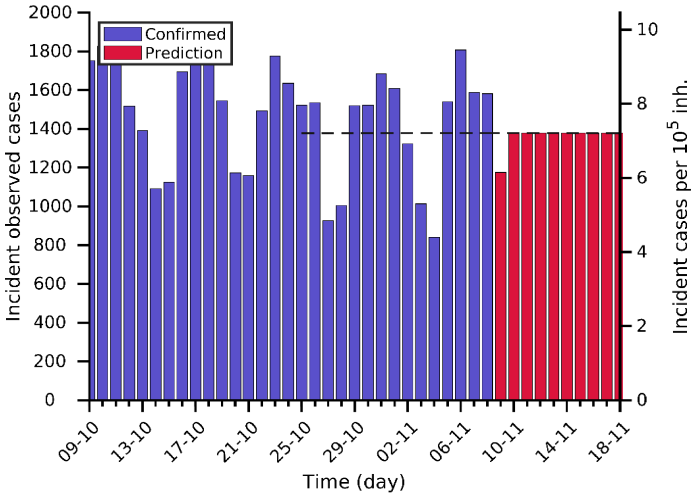


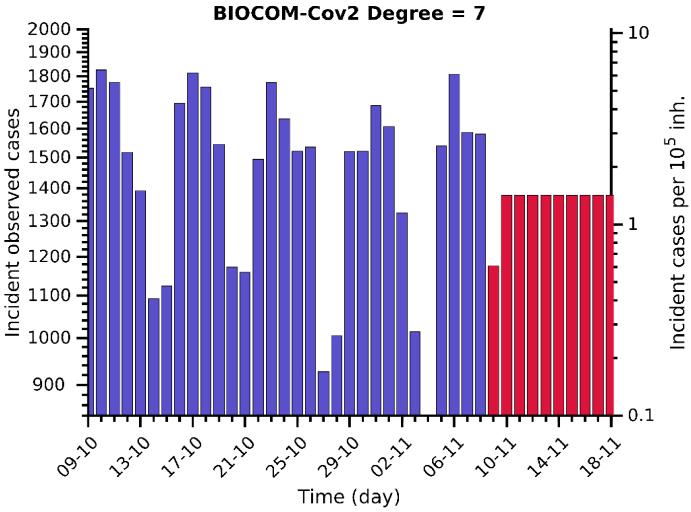
Predictions for next days

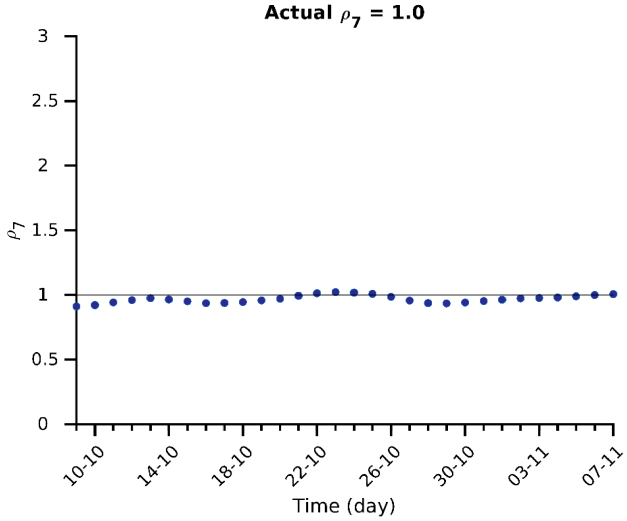
Day	Number of cases	95% Confidence Interval
11-11-2020	525490 (+3932)	[521792 - 529189]
15-11-2020	531003 (+9445)	[521692 - 540313]
18-11-2020	535136 (+13578)	[521558 - 552911]

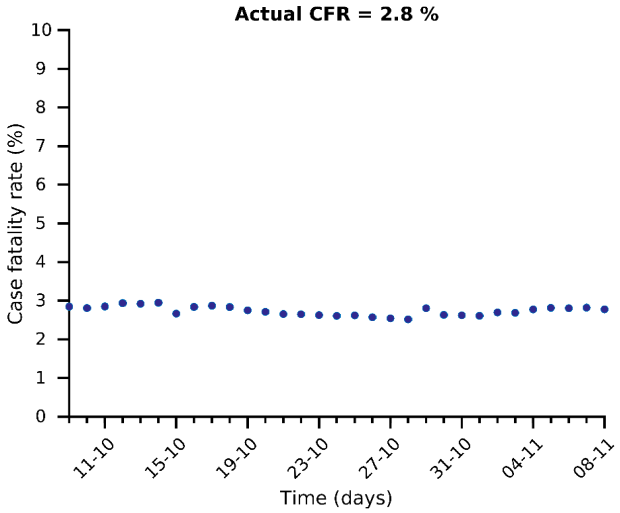
Current indicators

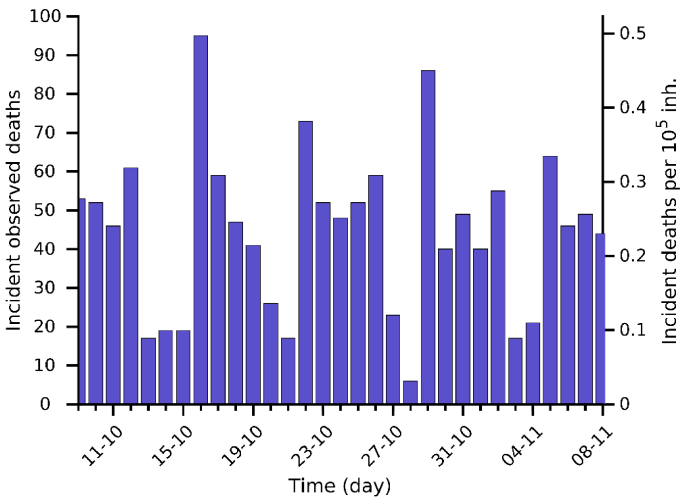
	A14	EPG	CFR	N7	D7
Today	102	103	2.78 %	1385	42
A Week ago	105	100	2.61 %	1400	43
Maximum	570	1031	4.98 %	10305	230

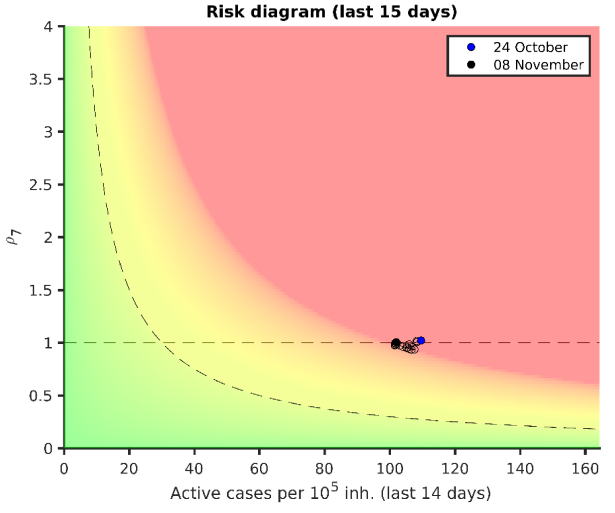




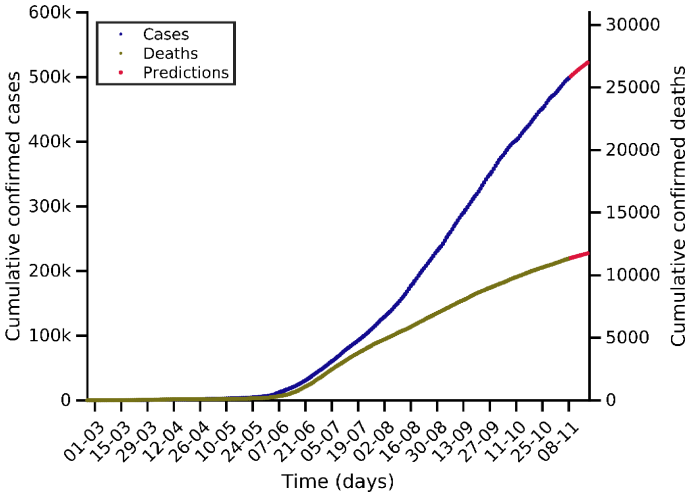








Iraq 08-11-2020. Pop: 40.2M. Cumulative incidence: 1239/10^5

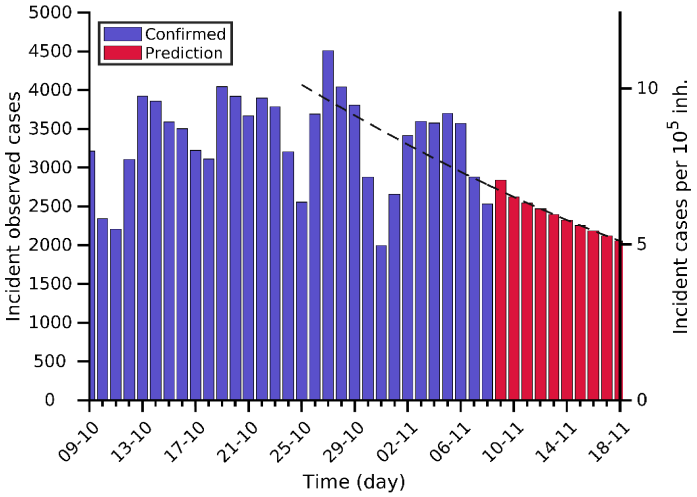


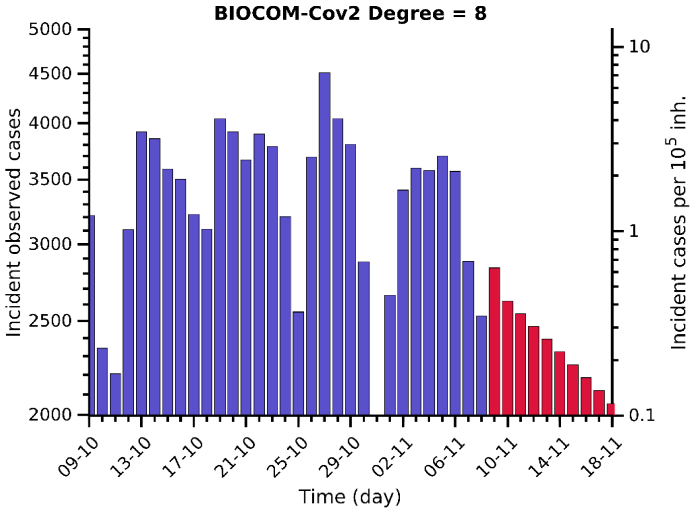
Predictions for next days

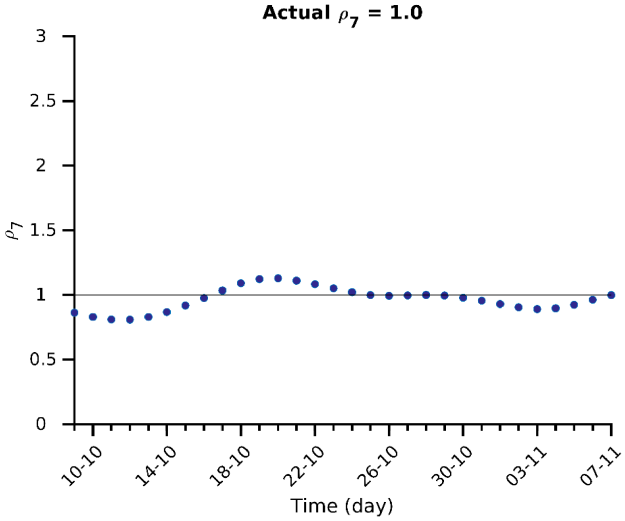
Day	Number of cases	95% Confidence Interval
11-11-2020	506553 (+8004)	[502046 - 511060]
15-11-2020	515995 (+17446)	[508029 - 523961]
18-11-2020	522352 (+23803)	[509264 - 535441]

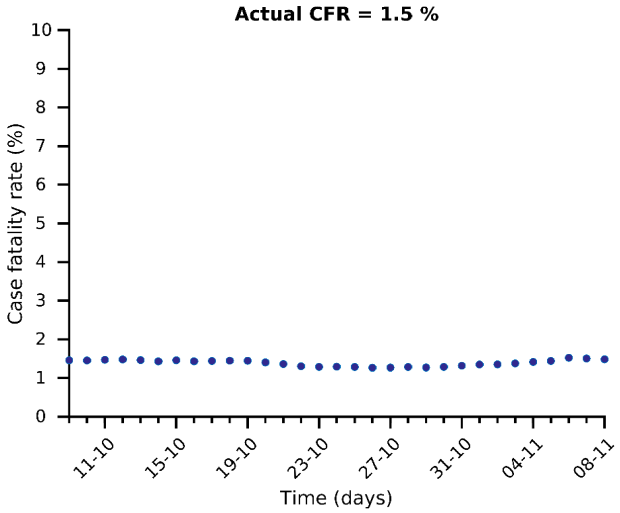
Current indicators

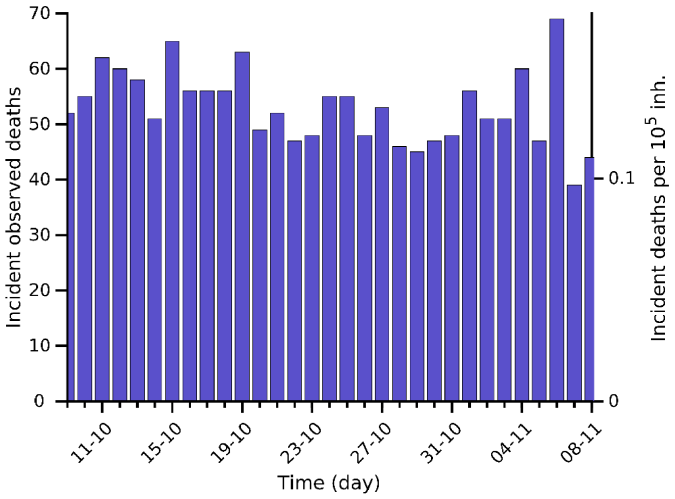
	A14	EPG	CFR	N7	D7
Today	116	116	1.48 %	3323	52
A Week ago	121	116	1.35 %	3369	49
Maximum	151	162	4.96 %	4505	106

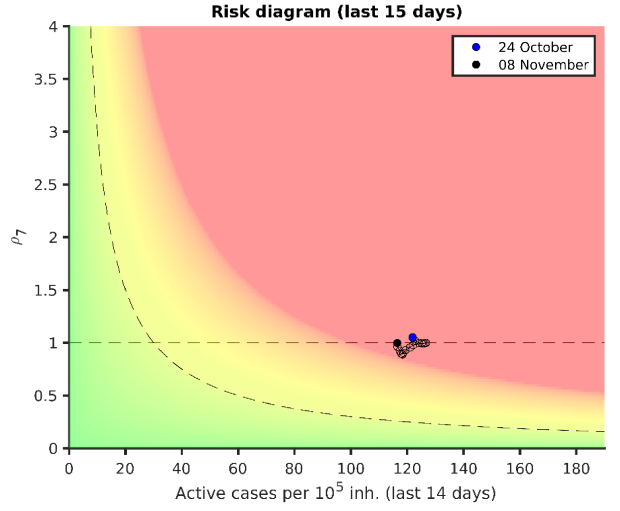




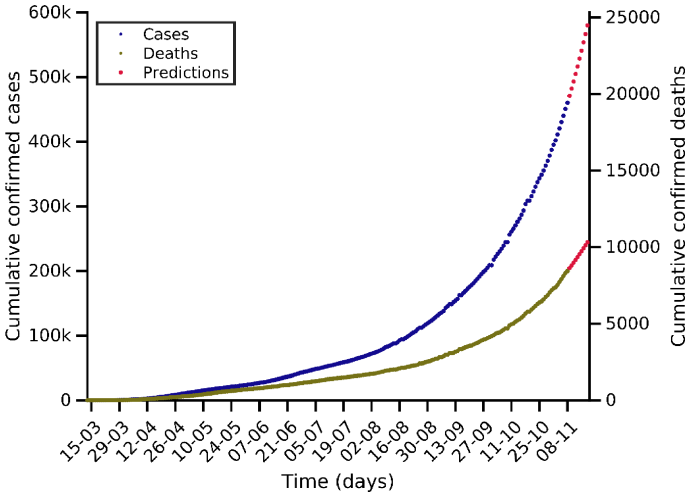








Ukraine 08-11-2020. Pop: 43.7M. Cumulative incidence: $1053/10^5$

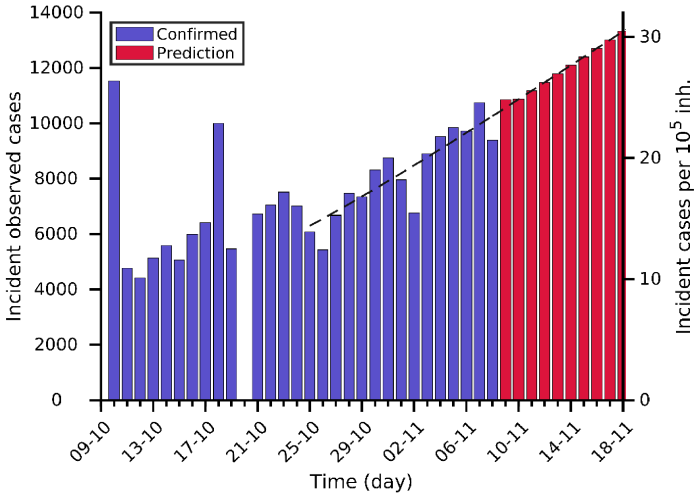


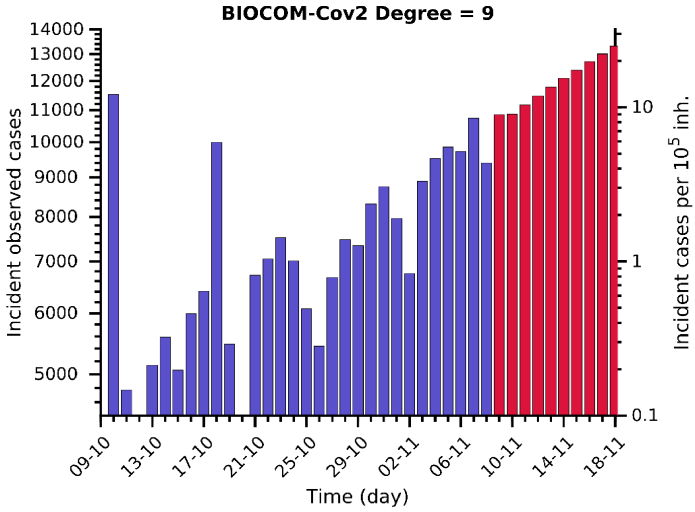
Predictions for next days

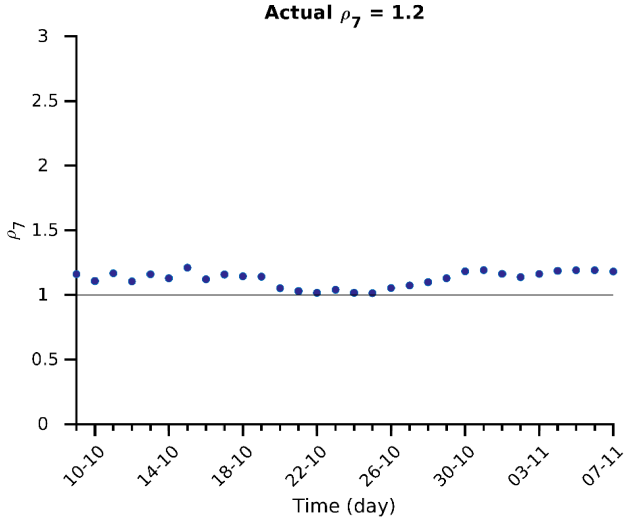
Day	Number of cases	95% Confidence Interval
11-11-2020	493235 (+32904)	[485245 - 501225]
15-11-2020	541001 (+80670)	[520174 - 561828]
18-11-2020	580040 (+119709)	[537529 - 622551]

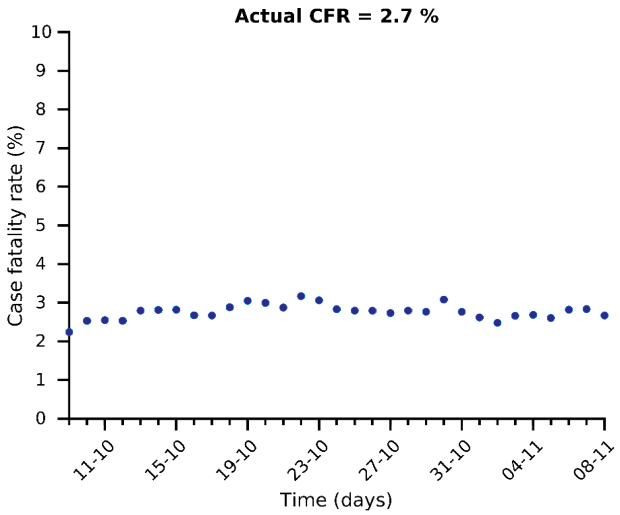
Current indicators

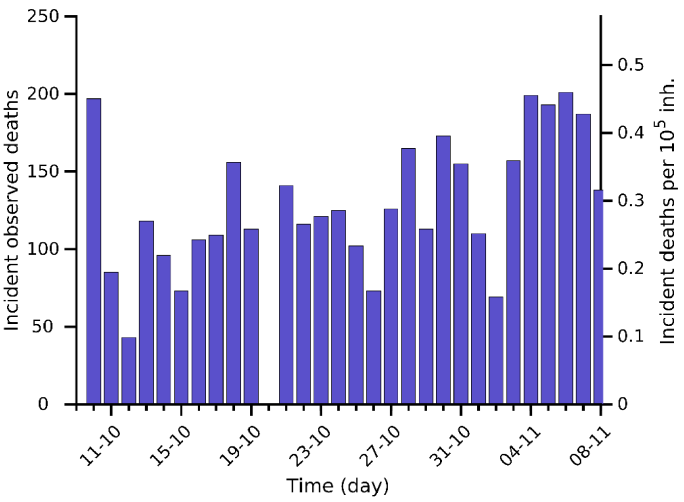
	A14	EPG	CFR	N7	D7
Today	267	316	2.67 %	9270	163
A Week ago	210	250	2.62 %	7422	131
Maximum	267	316	4.96 %	9270	163

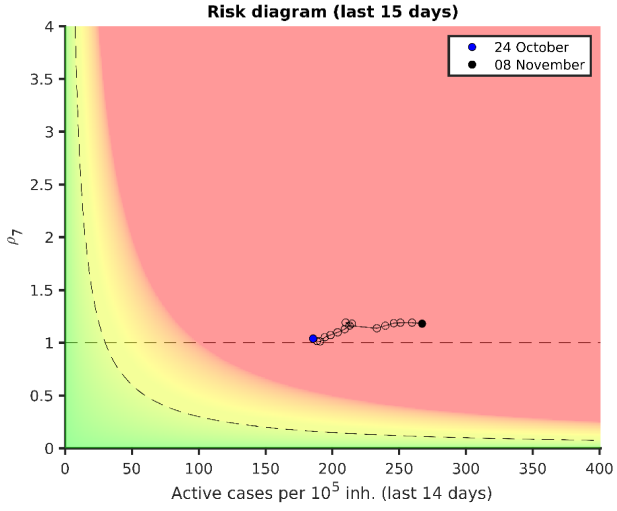




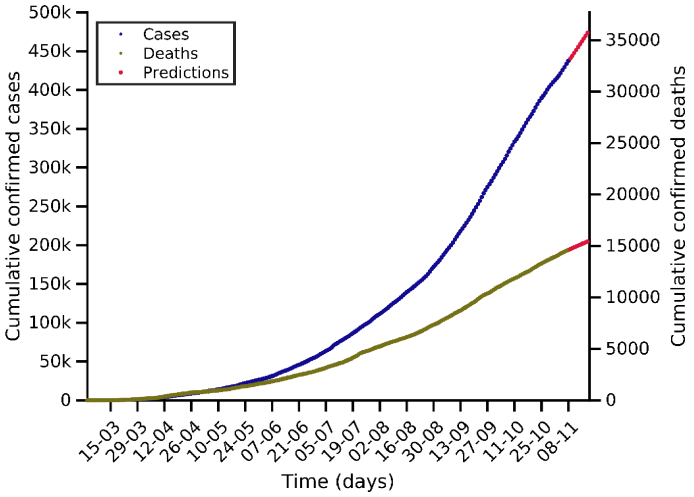








Indonesia 08-11-2020. Pop: 273.5M. Cumulative incidence: 160/10^5

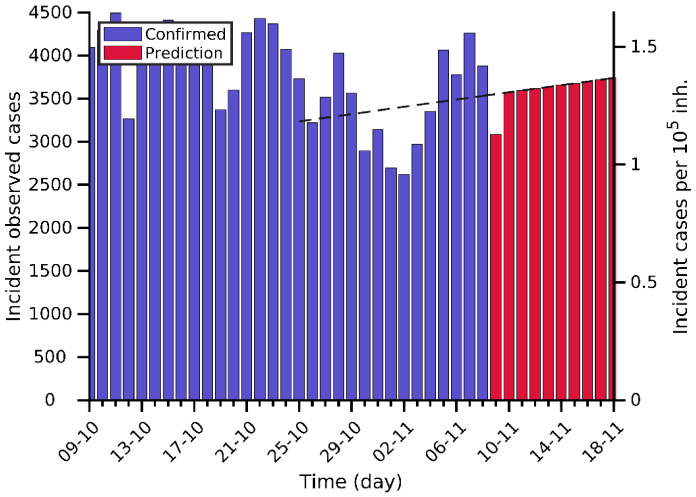


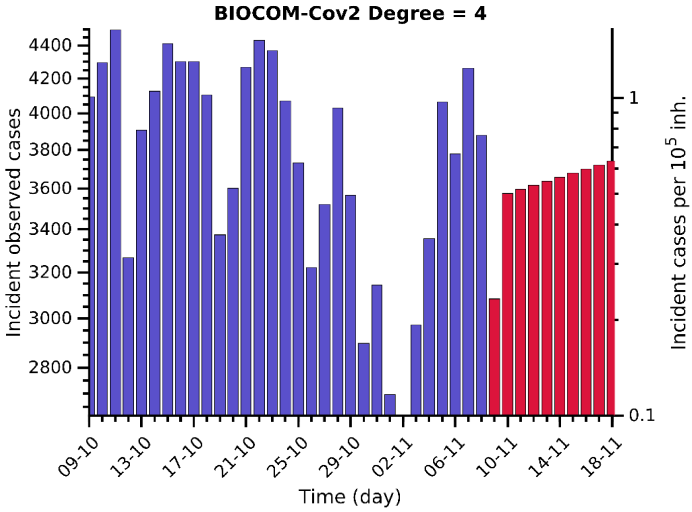
Predictions for next days

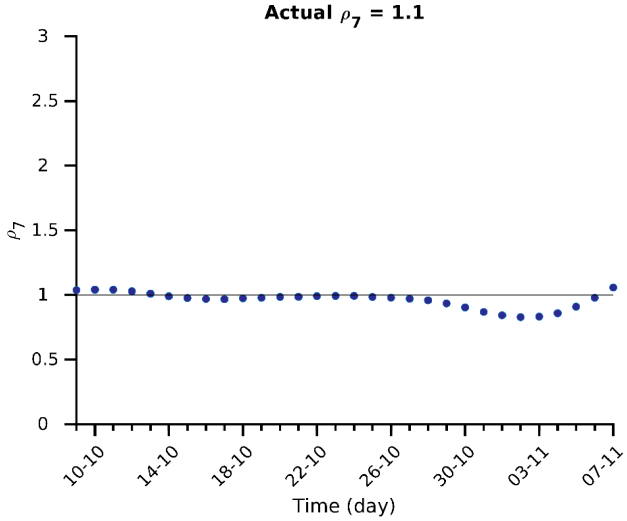
Day	Number of cases	95% Confidence Interval
11-11-2020	447969 (+10253)	[439045 - 456893]
15-11-2020	462559 (+24843)	[441793 - 483324]
18-11-2020	473718 (+36002)	[437716 - 514001]

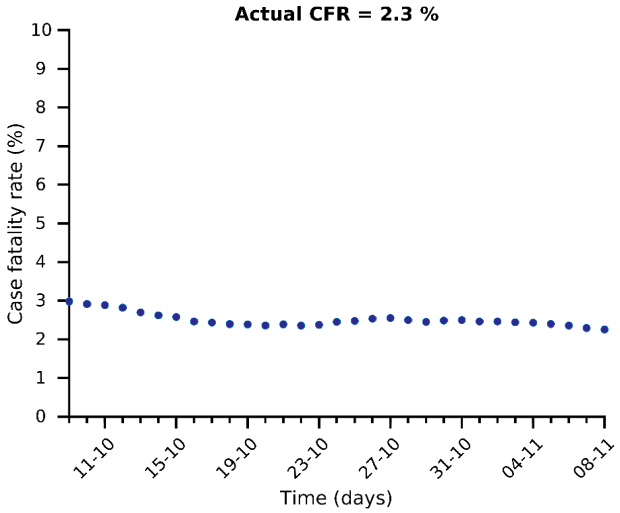
Current indicators

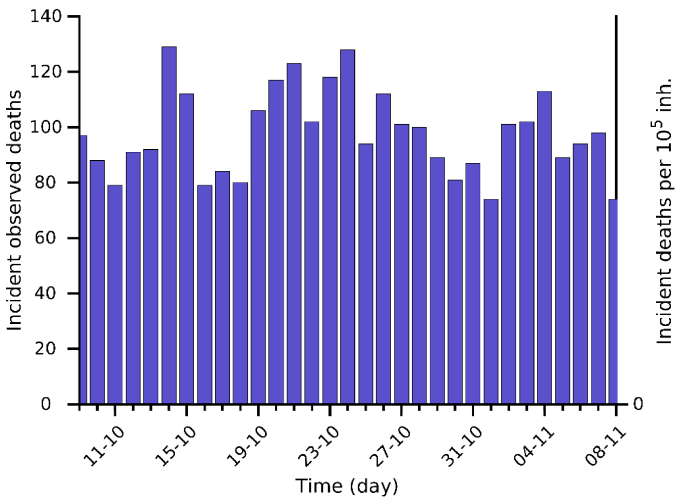
	A14	EPG	CFR	N7	D7
Today	18	19	2.25 %	3562	96
A Week ago	19	16	2.46 %	3296	92
Maximum	22	23	4.98 %	4379	126

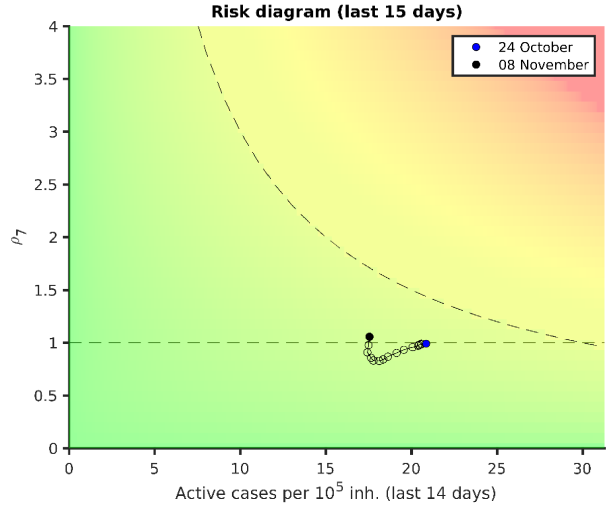




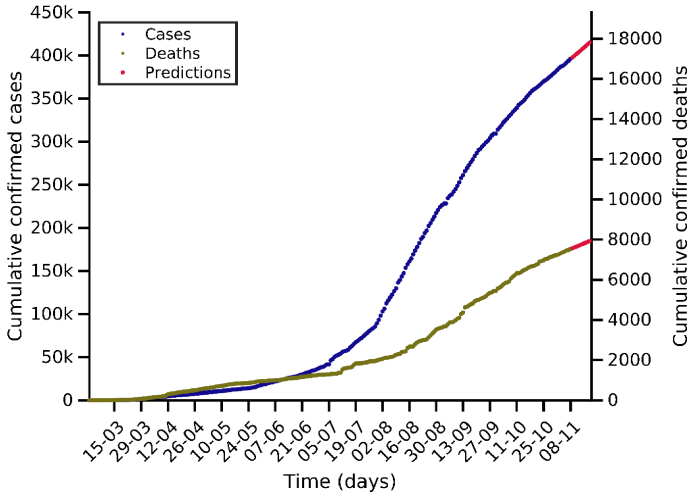








Philippines 08-11-2020. Pop: 109.6M. Cumulative incidence: 362/10⁵

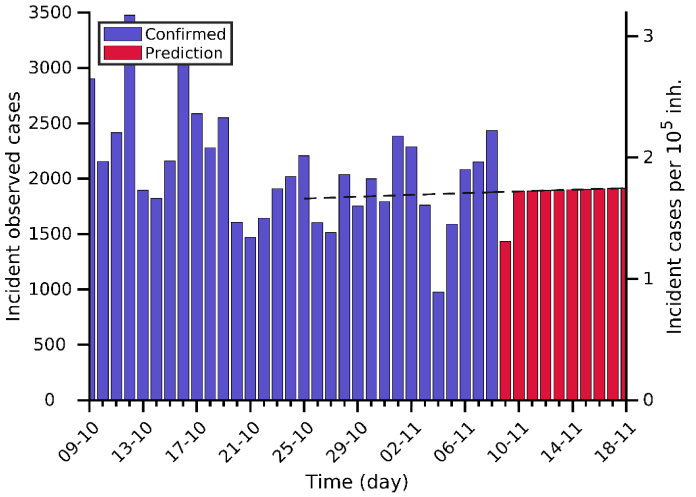


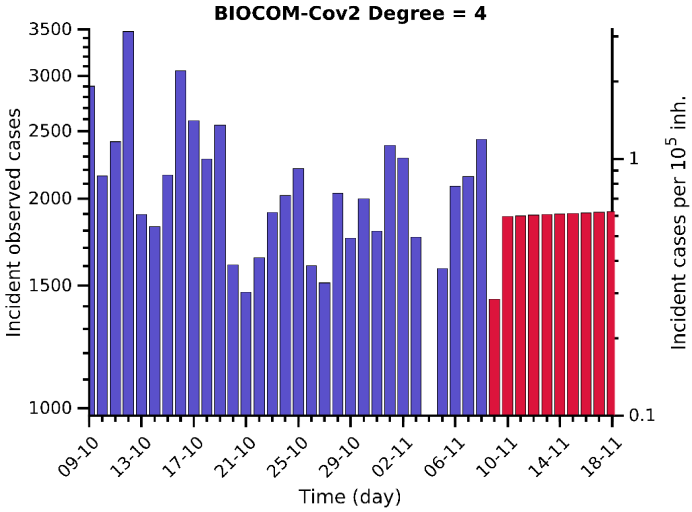
Predictions for next days

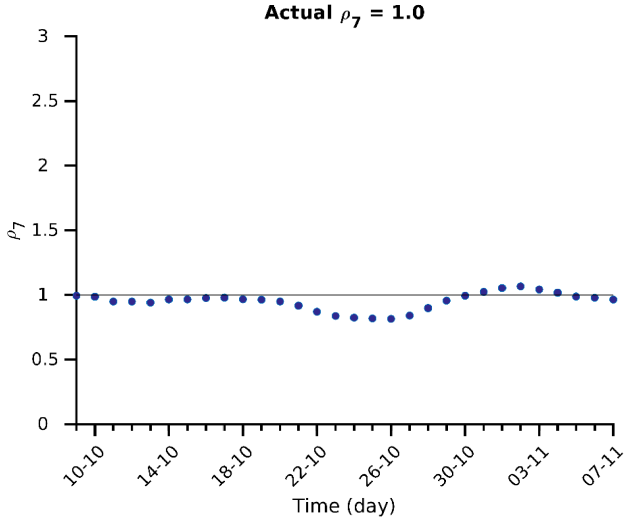
Day	Number of cases	95% Confidence Interval
11-11-2020	401604 (+5209)	[396395 - 408069]
15-11-2020	409200 (+12805)	[396395 - 423918]
18-11-2020	414936 (+18541)	[396395 - 443157]

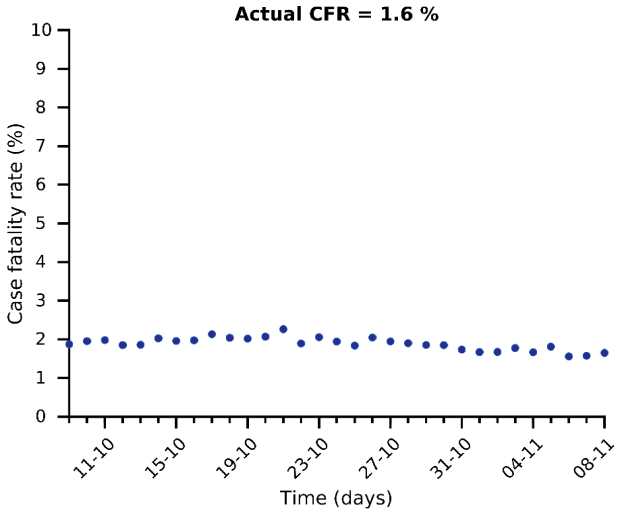
Current indicators

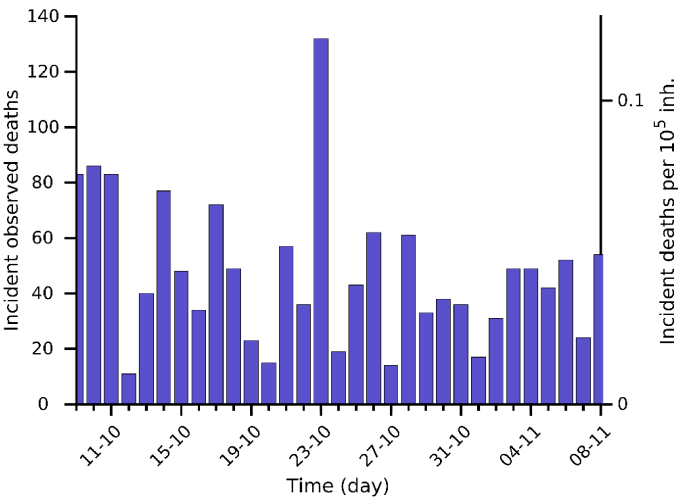
	A14	EPG	CFR	N7	D7
Today	24	23	1.65 %	1897	43
A Week ago	24	25	1.67 %	1869	37
Maximum	55	74	4.92 %	4477	107

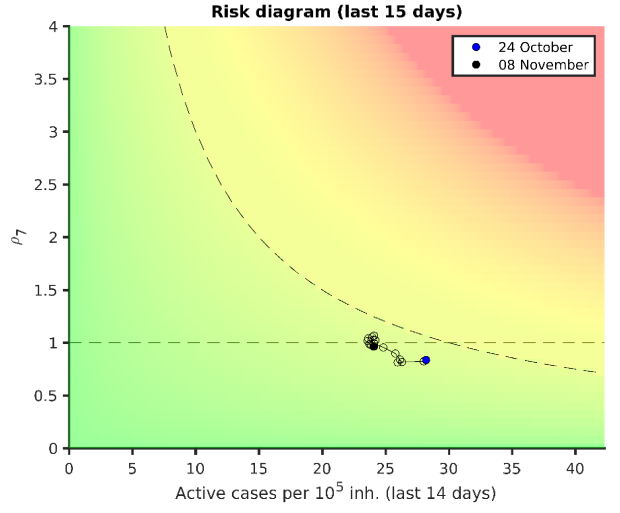




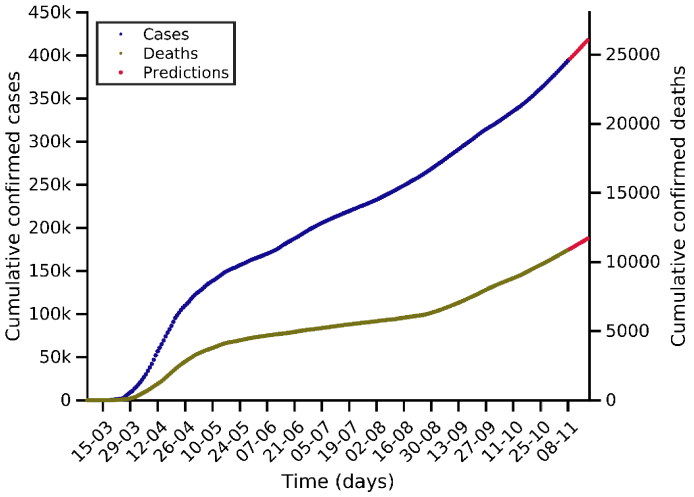








Turkey 08-11-2020. Pop: 84.3M. Cumulative incidence: 467/10^5

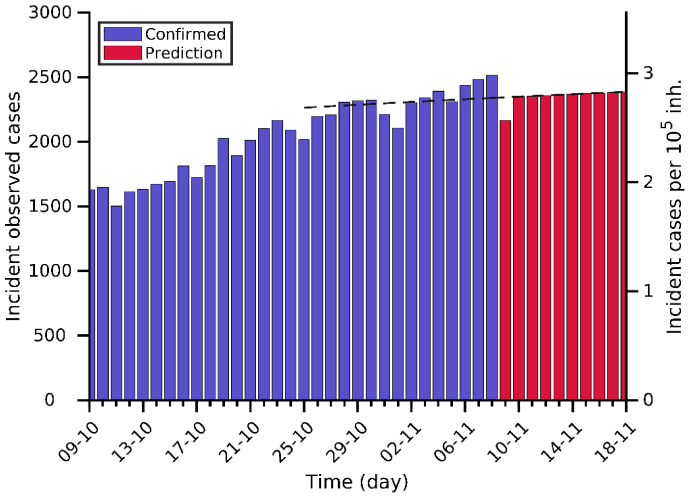


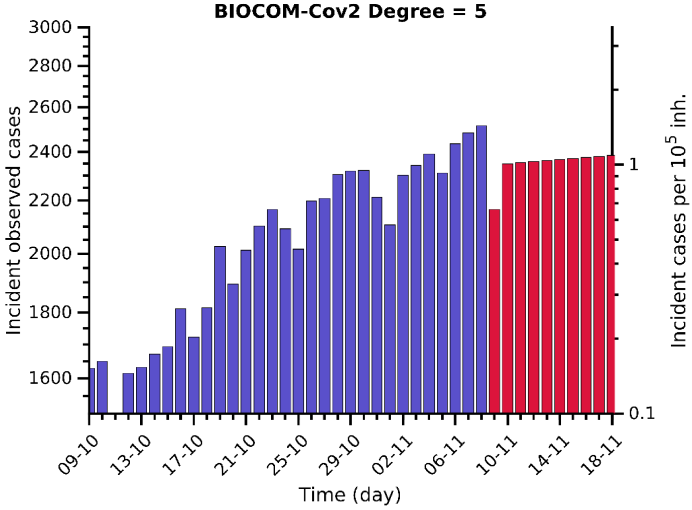
Predictions for next days

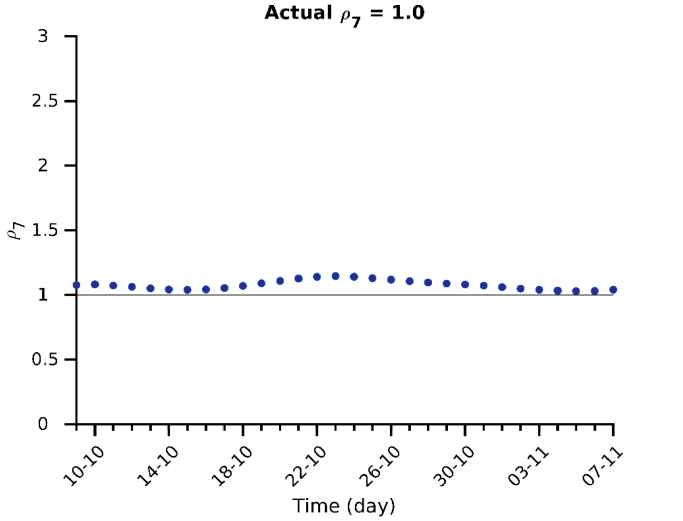
Day	Number of cases	95% Confidence Interval
11-11-2020	401123 (+6868)	[398613 - 403633]
15-11-2020	410586 (+16331)	[404945 - 416227]
18-11-2020	417730 (+23475)	[406943 - 428517]

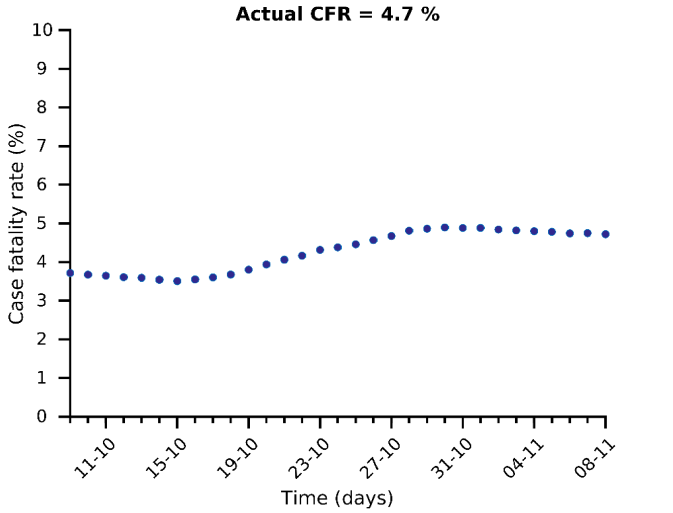
Current indicators

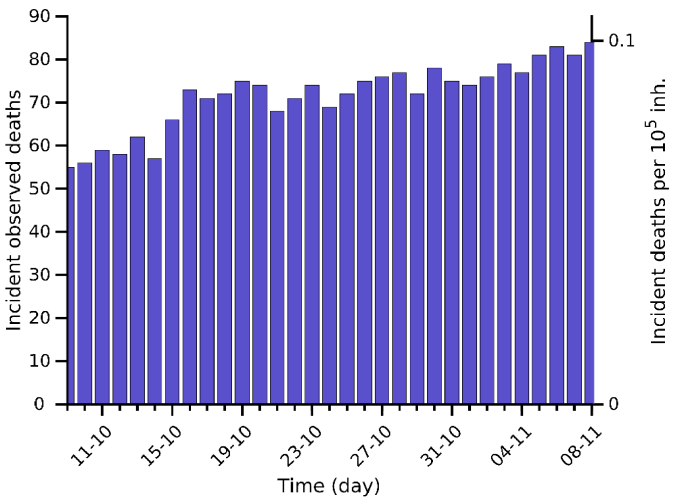
	A14	EPG	CFR	N7	D7
Today	38	40	4.72 %	2397	80
A Week ago	36	38	4.88 %	2239	75
Maximum	73	85	4.93 %	4559	123

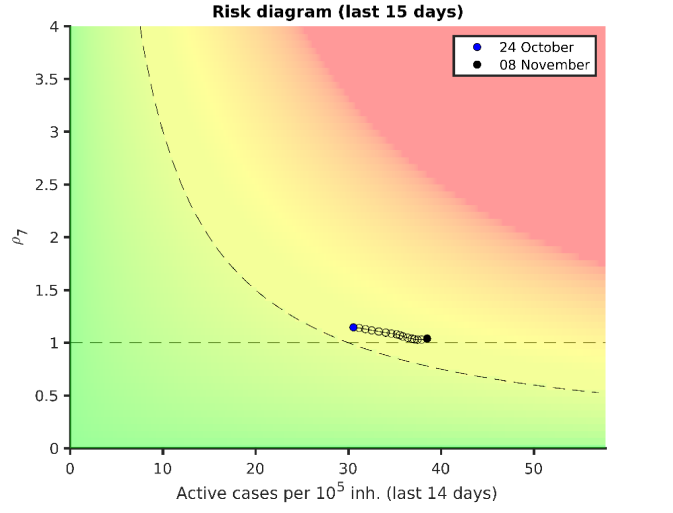




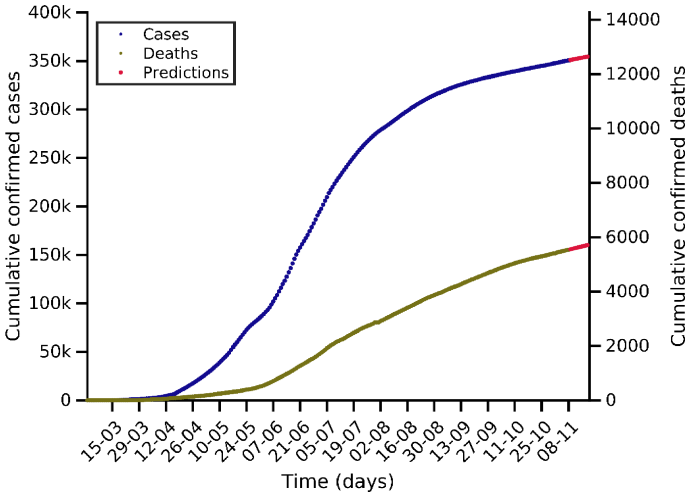








Saudi Arabia 08-11-2020. Pop: 34.8M. Cumulative incidence: 1007/10^5

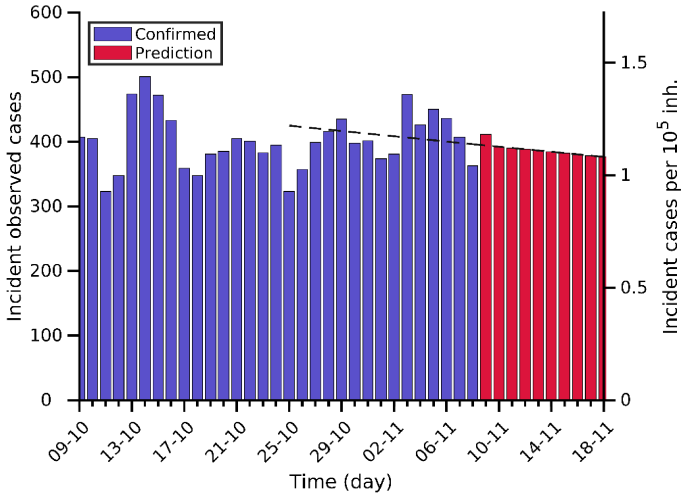


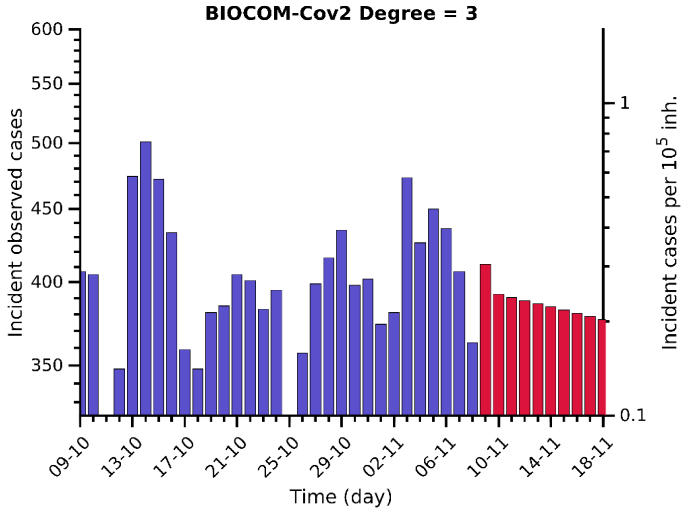
Predictions for next days

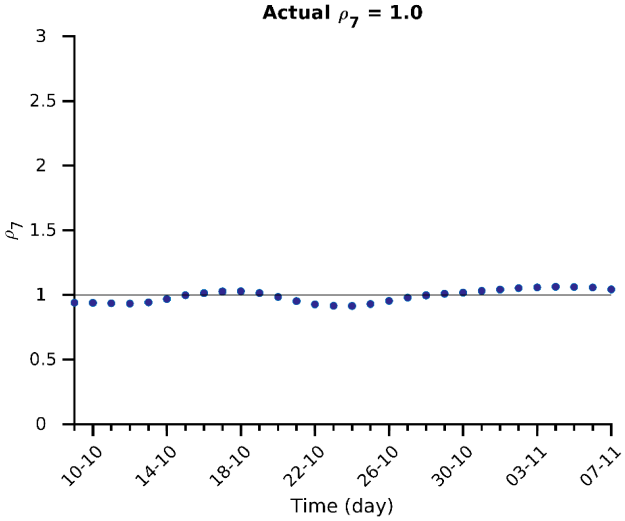
Day	Number of cases	95% Confidence Interval
11-11-2020	351786 (+1194)	[351405 - 352167]
15-11-2020	353328 (+2736)	[352871 - 353785]
18-11-2020	354464 (+3872)	[353885 - 355043]

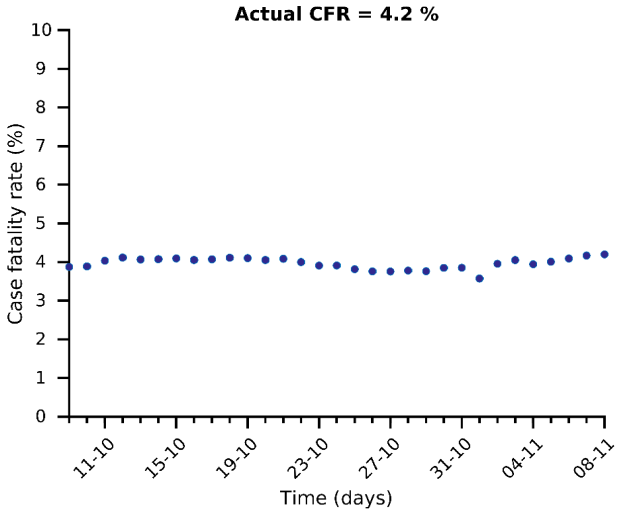
Current indicators

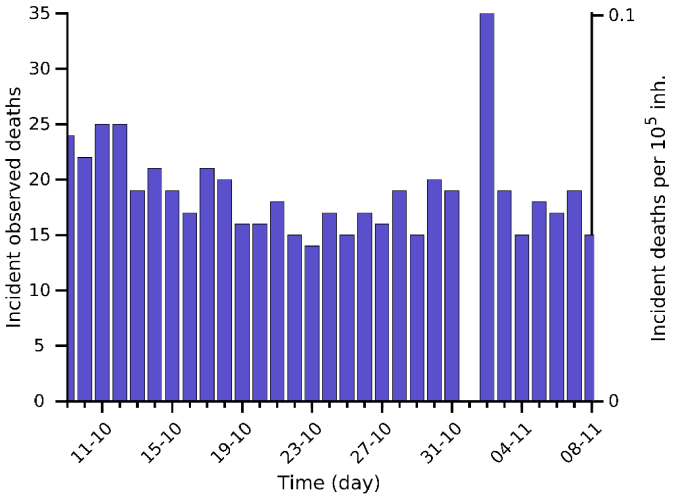
	A14	EPG	CFR	N7	D7
Today	16	17	4.20 %	419	20
A Week ago	16	16	3.57 %	397	15
Maximum	160	189	4.97 %	4418	53

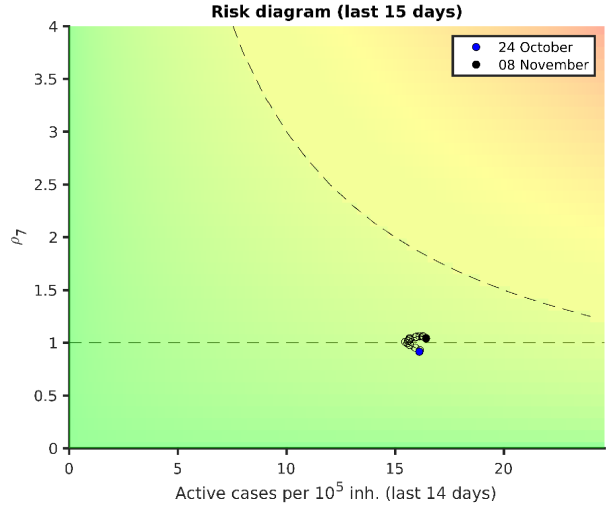




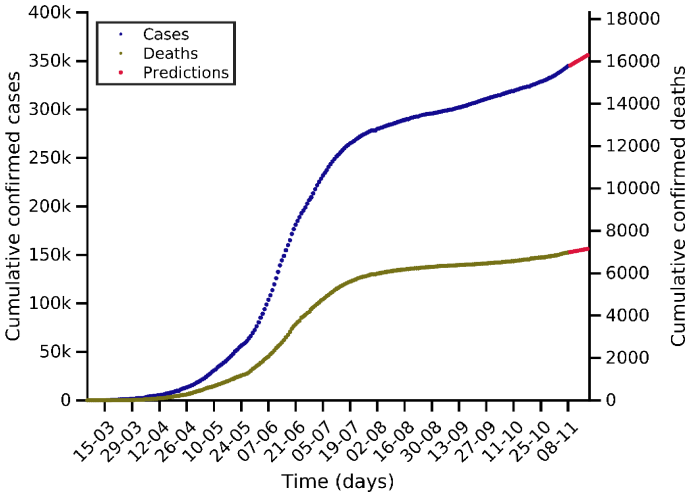








Pakistan 08-11-2020. Pop: 220.9M. Cumulative incidence: 156/10^5

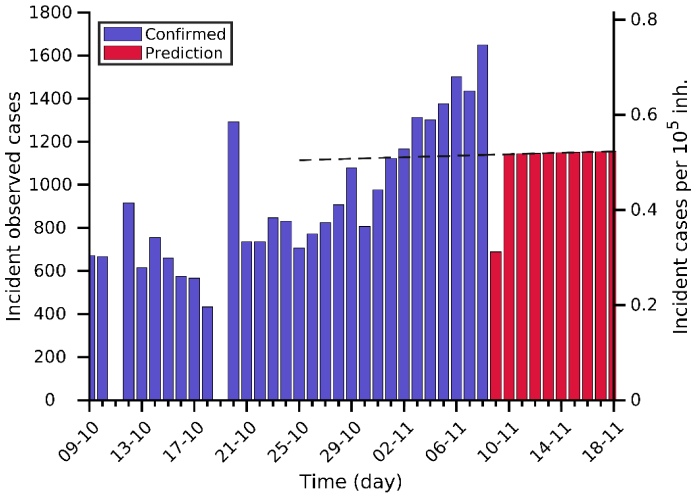


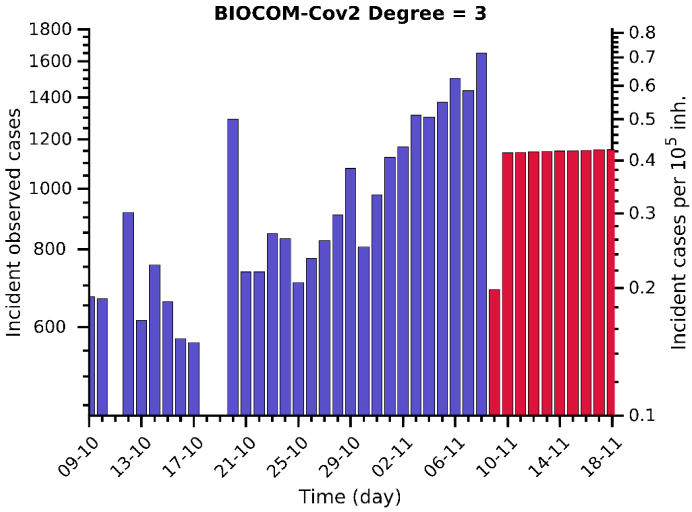
Predictions for next days

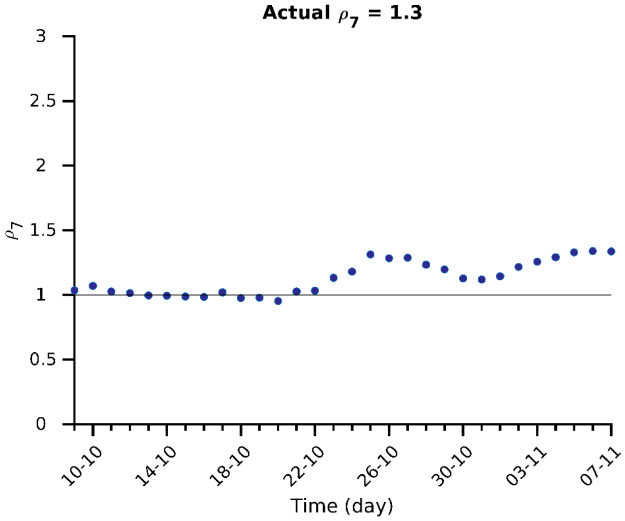
Day	Number of cases	95% Confidence Interval
11-11-2020	347814 (+2975)	[344839 - 355549]
15-11-2020	352405 (+7566)	[344839 - 372625]
18-11-2020	355866 (+11027)	[344839 - 394887]

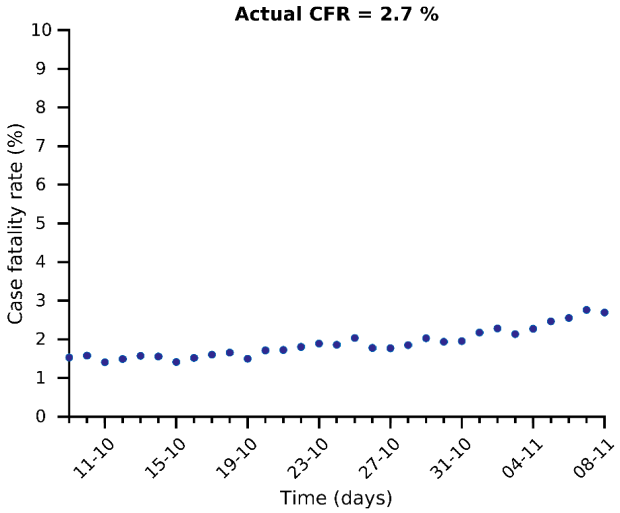
Current indicators

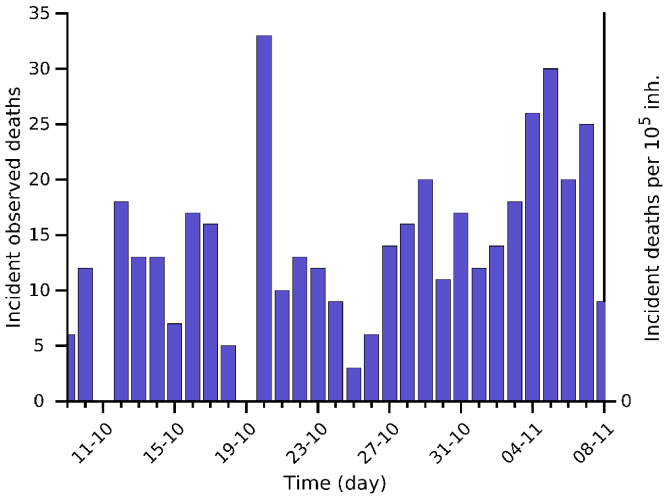
	A14	EPG	CFR	N7	D7
Today	7	10	2.69 %	1392	20
A Week ago	5	6	2.18 %	927	14
Maximum	35	40	4.90 %	5865	124

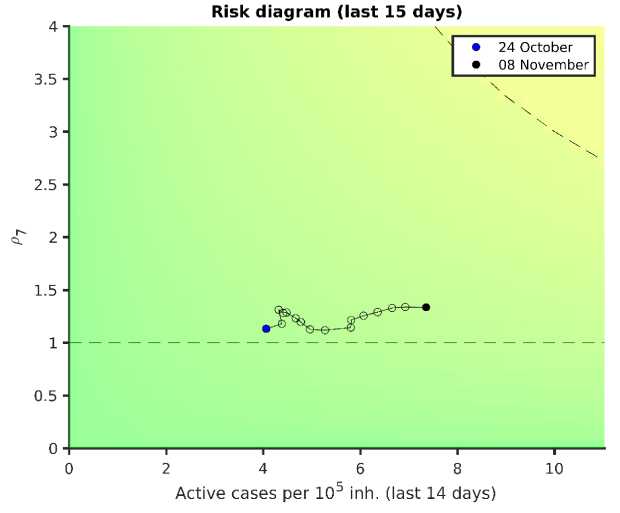




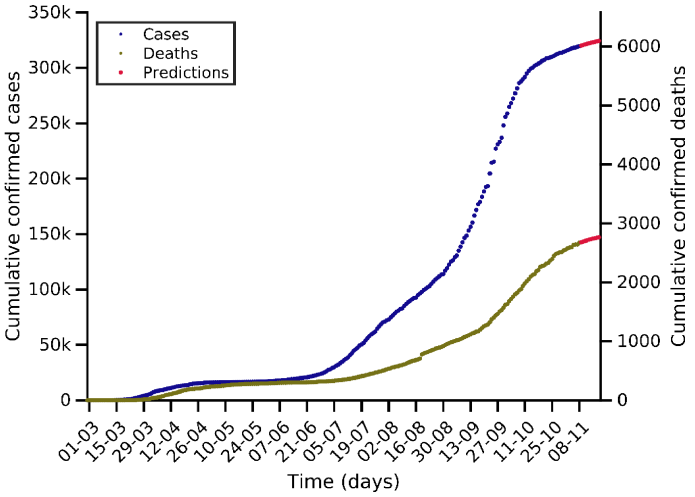








Israel 08-11-2020. Pop: 8.7M. Cumulative incidence: 3692/10^5

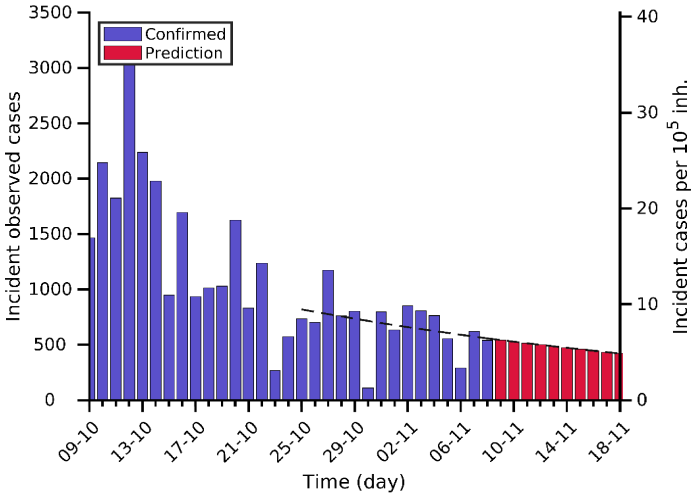


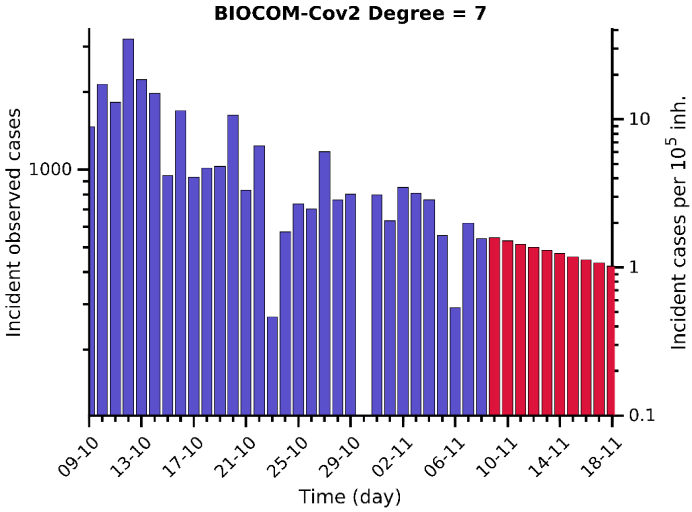
Predictions for next days

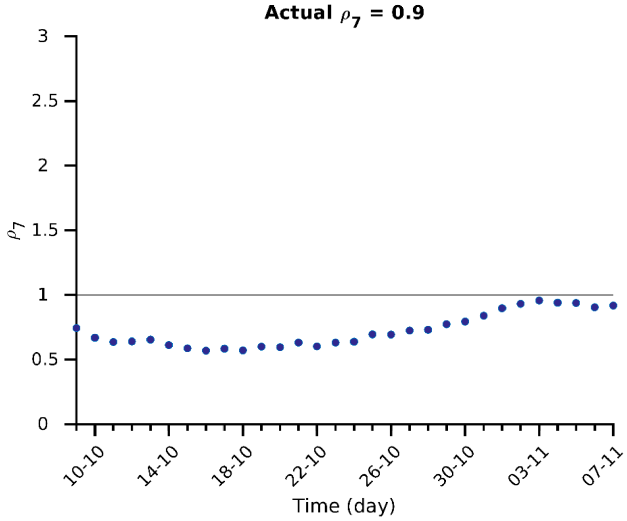
Day	Number of cases	95% Confidence Interval
11-11-2020	321147 (+1585)	[320343 - 321952]
15-11-2020	323064 (+3502)	[322103 - 324025]
18-11-2020	324366 (+4804)	[323189 - 325544]

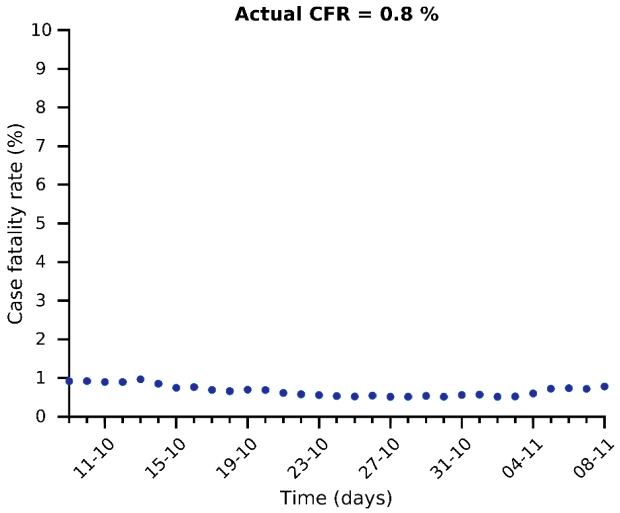
Current indicators

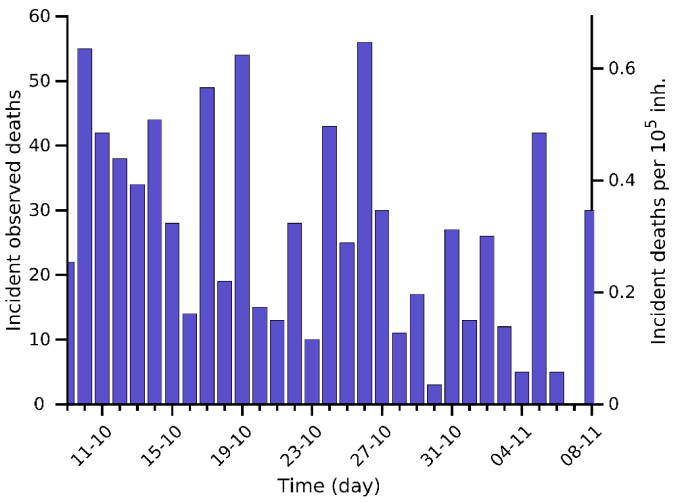
	A14	EPG	CFR	N7	D7
Today	109	100	0.78 %	633	17
A Week ago	130	109	0.57 %	712	22
Maximum	966	1164	4.99 %	6233	39

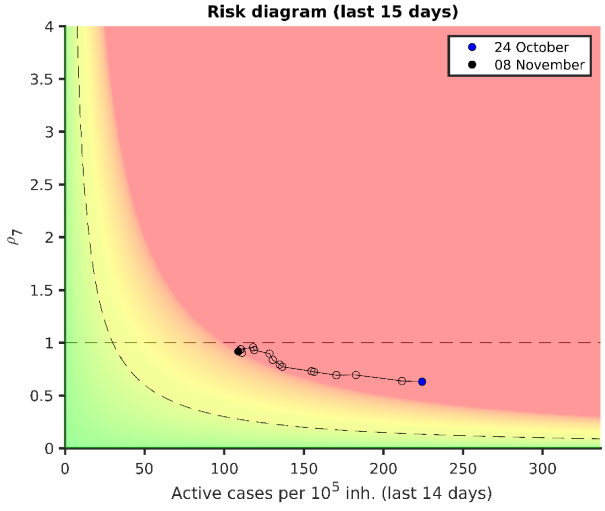




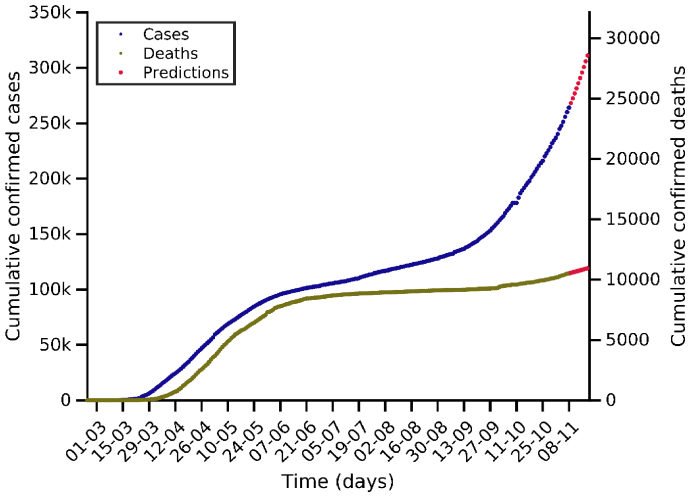








Canada 08-11-2020. Pop: 37.7M. Cumulative incidence: 700/10⁵

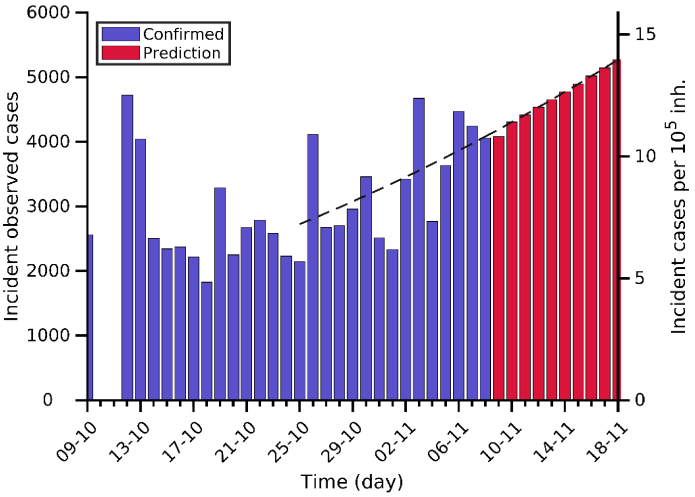


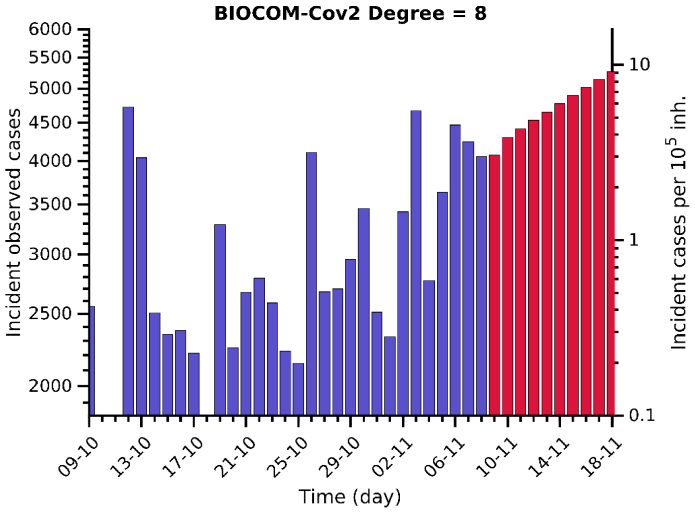
Predictions for next days

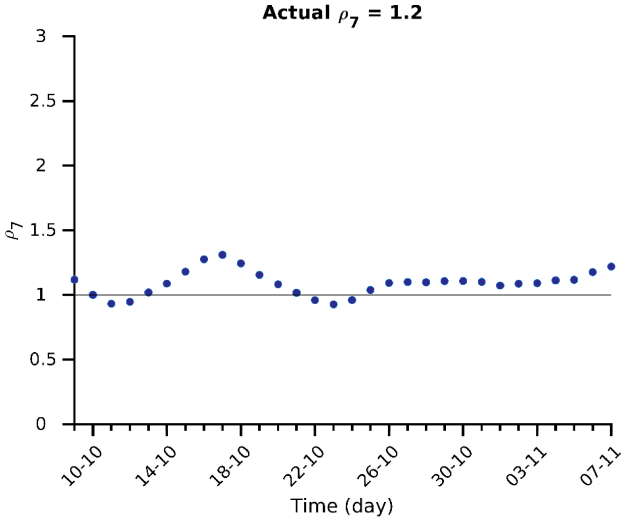
Day	Number of cases	95% Confidence Interval
11-11-2020	276914 (+12801)	[273121 - 280706]
15-11-2020	295767 (+31654)	[285781 - 305752]
18-11-2020	311197 (+47084)	[290598 - 331796]

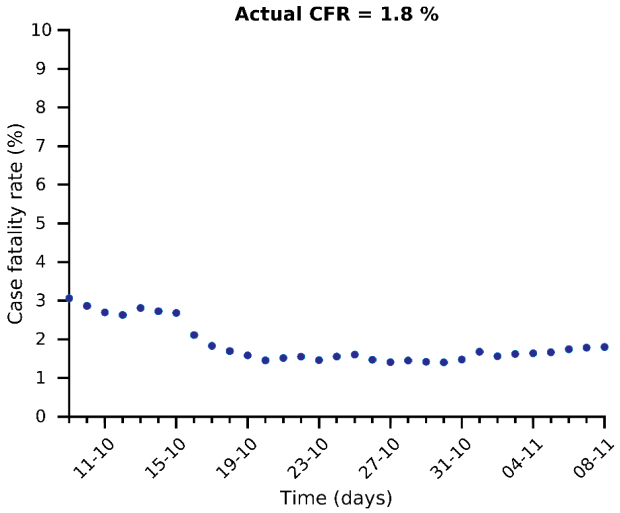
Current indicators

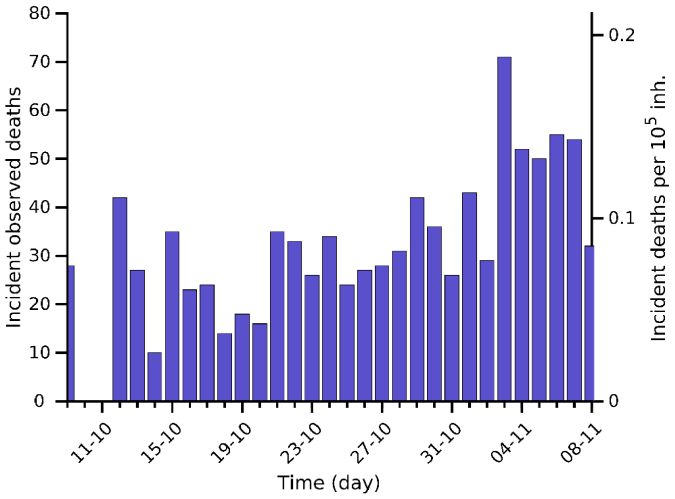
	A14	EPG	CFR	N7	D7
Today	127	155	1.80 %	3896	49
A Week ago	103	113	1.68 %	2962	33
Maximum	127	155	4.96 %	3896	177

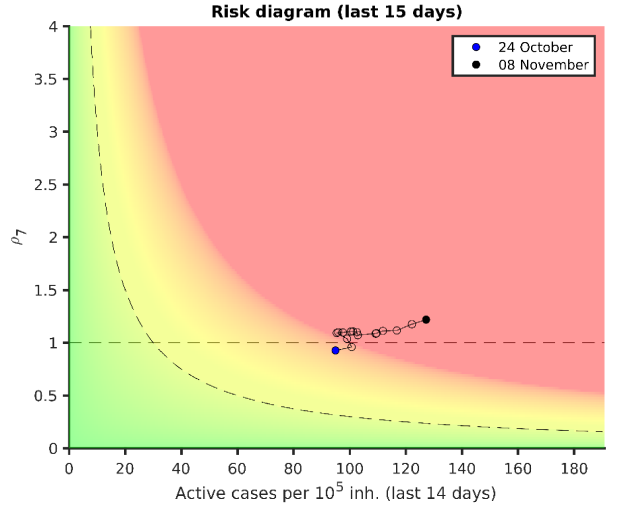




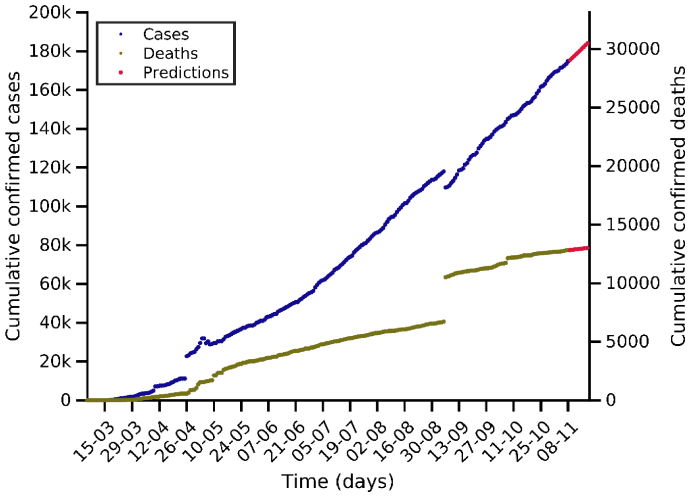








Ecuador 08-11-2020. Pop: 17.6M. Cumulative incidence: 991/10^5

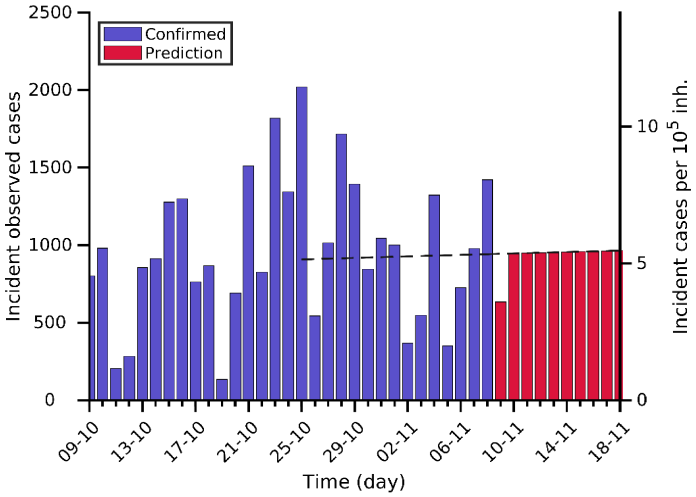


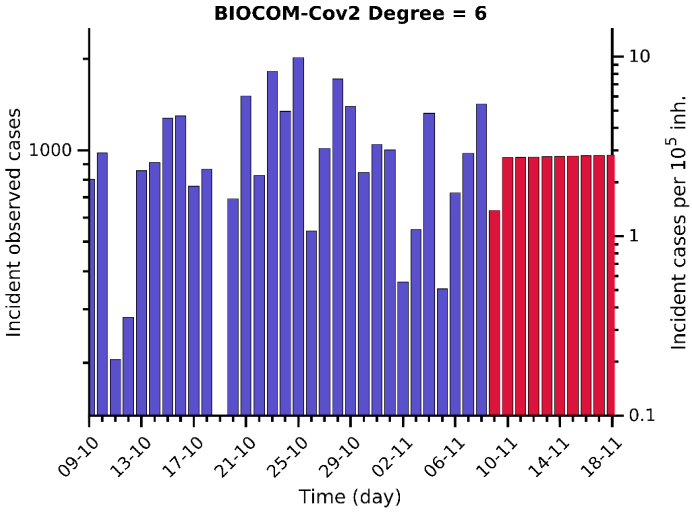
Predictions for next days

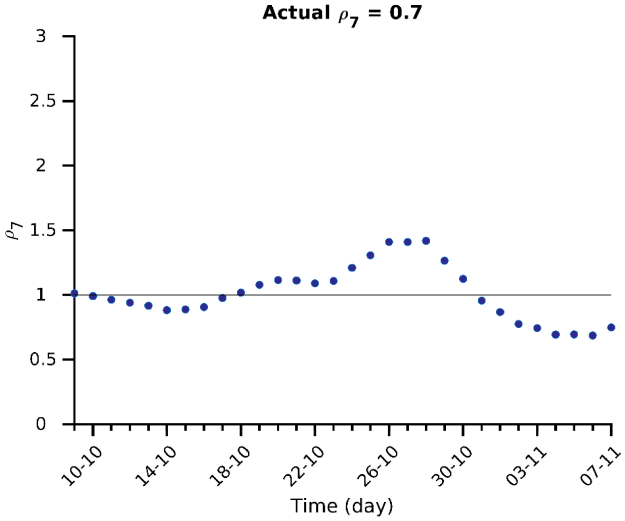
Day	Number of cases	95% Confidence Interval
11-11-2020	177436 (+2529)	[174907 - 182371]
15-11-2020	181253 (+6346)	[174907 - 192537]
18-11-2020	184141 (+9234)	[174907 - 205862]

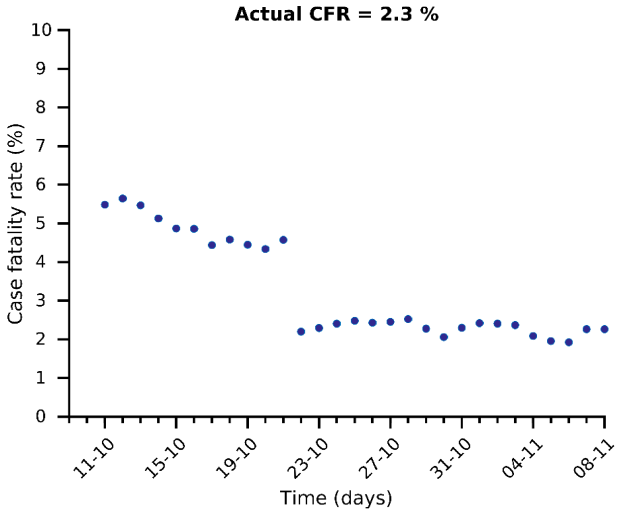
Current indicators

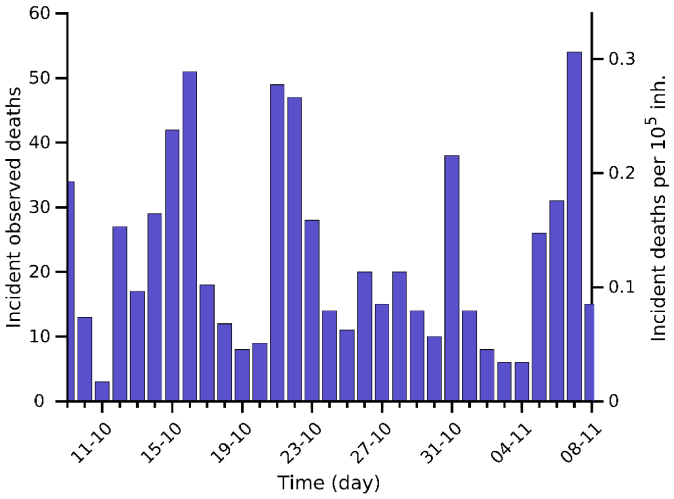
	A14	EPG	CFR	N7	D7
Today	75	56	2.26 %	816	21
A Week ago	90	86	2.42 %	1080	19
Maximum	123	500	4.89 %	2326	595

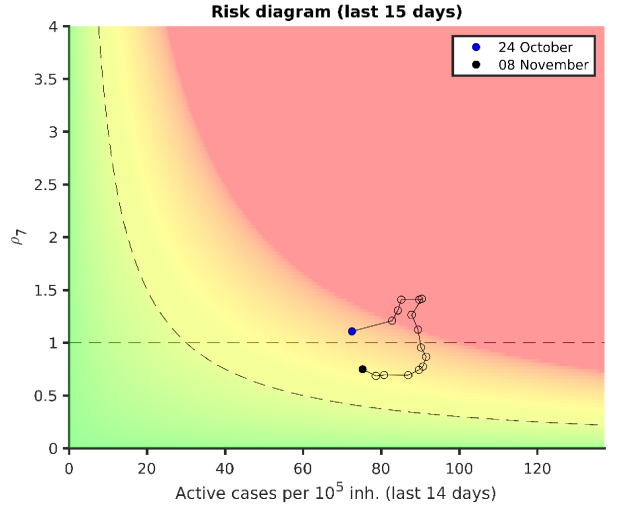




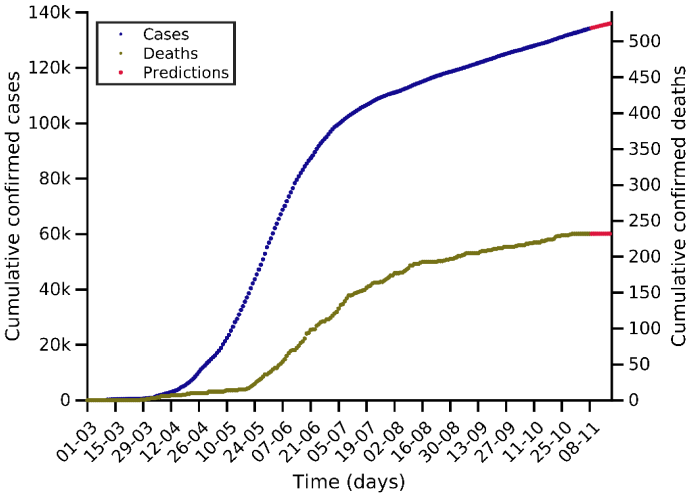








Qatar 08-11-2020. Pop: 2.9M. Cumulative incidence: 4658/10^5

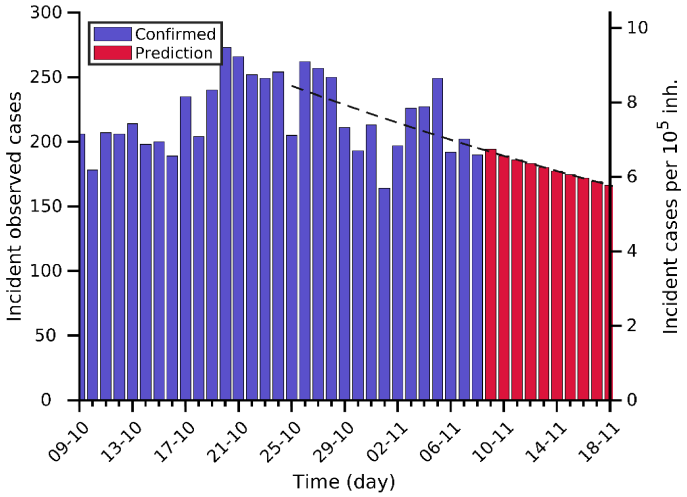


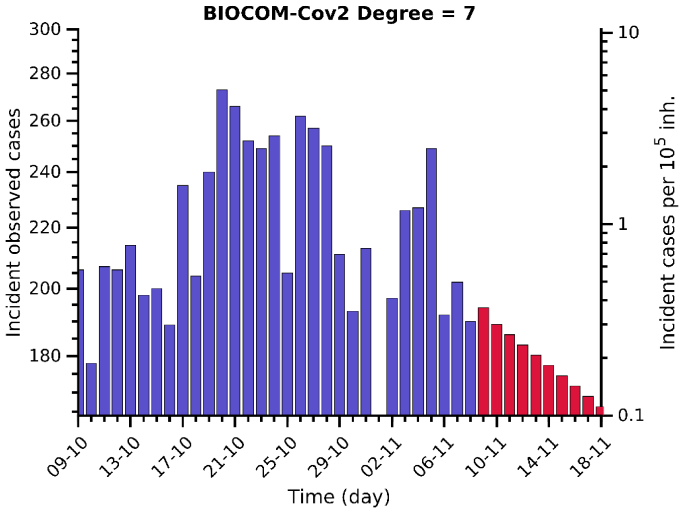
Predictions for next days

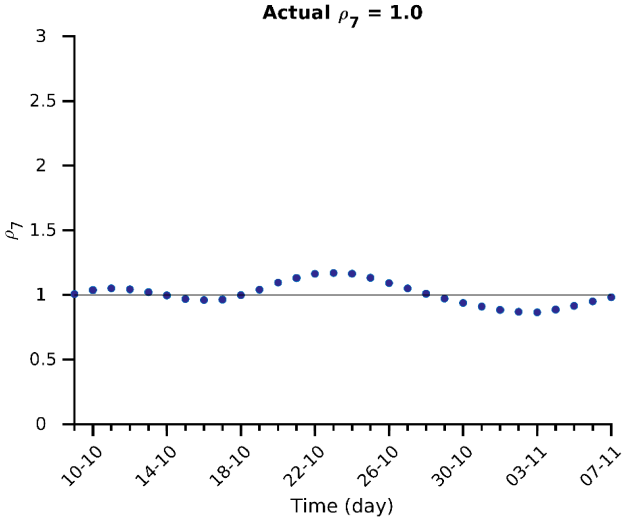
Day	Number of cases	95% Confidence Interval
11-11-2020	134772 (+569)	[134628 - 134917]
15-11-2020	135488 (+1285)	[135291 - 135684]
18-11-2020	135995 (+1792)	[135736 - 136253]

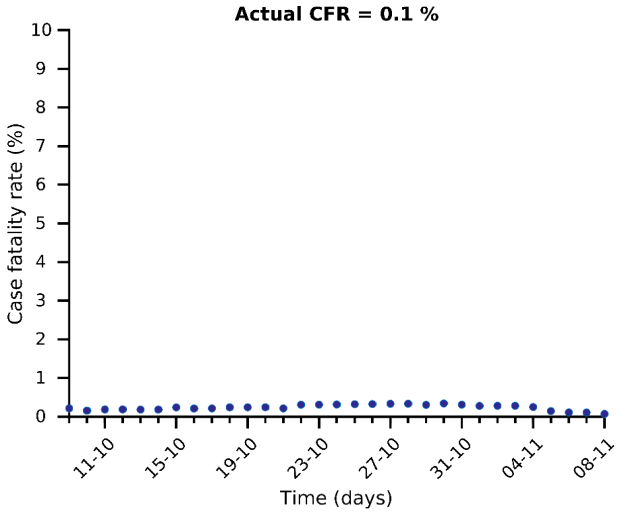
Current indicators

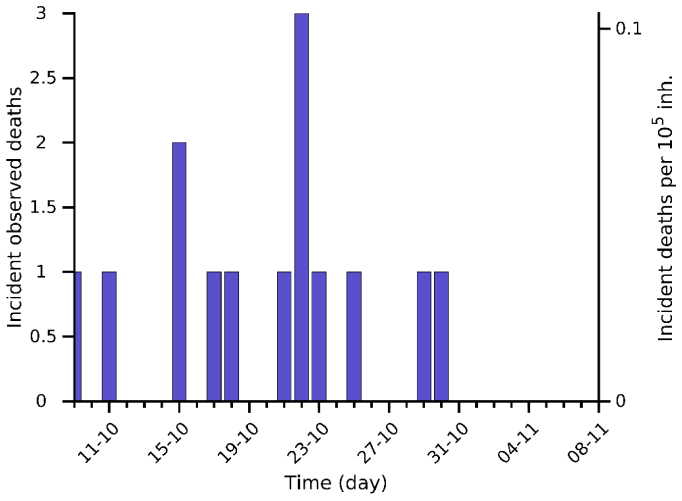
	A14	EPG	CFR	N7	D7
Today	105	103	0.07 %	212	0
A Week ago	114	104	0.28 %	221	0
Maximum	871	954	1.98 %	1888	4

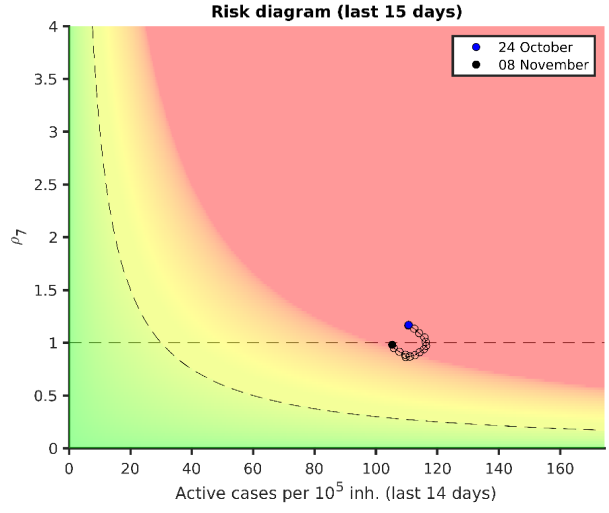




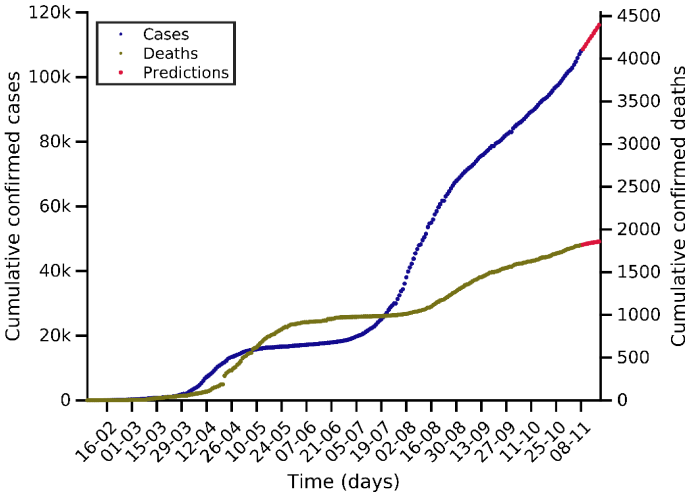








Japan 08-11-2020. Pop: 126.5M. Cumulative incidence: 85/10^5

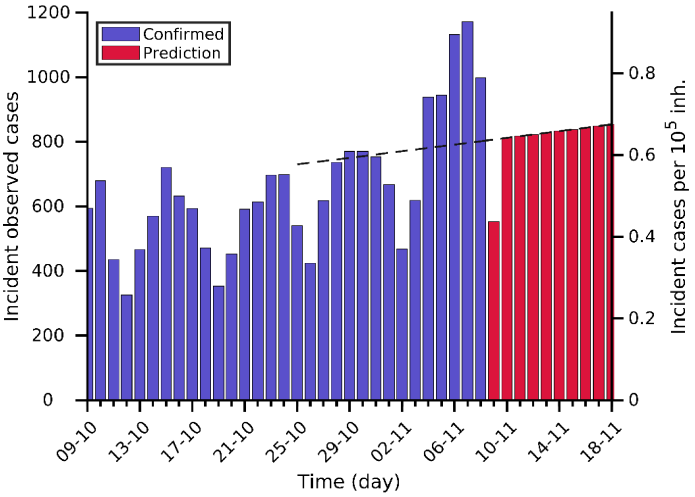


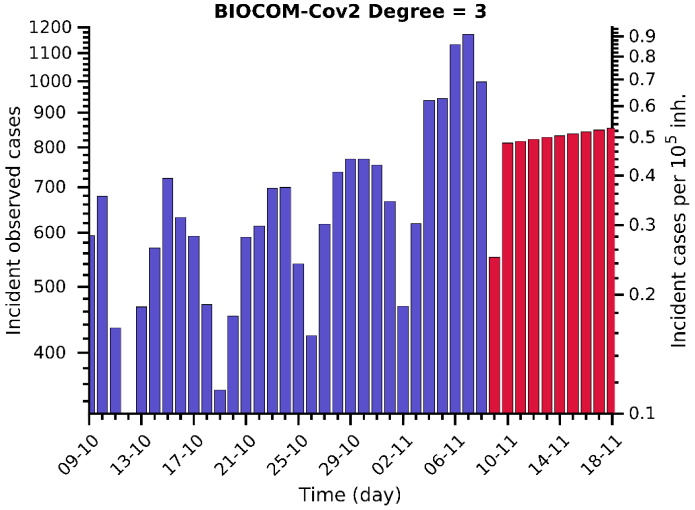
Predictions for next days

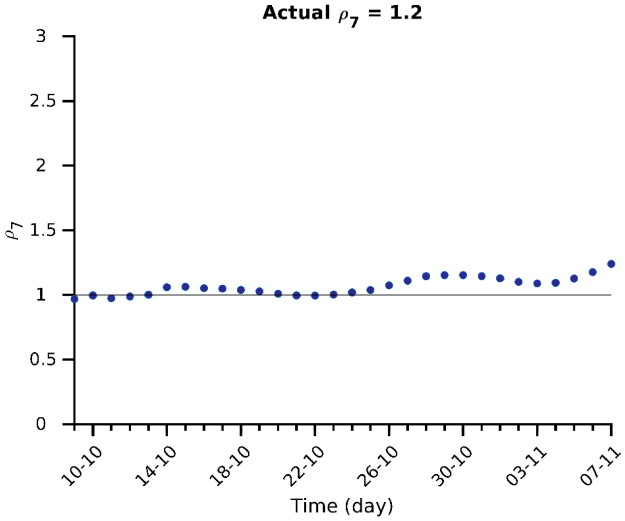
Day	Number of cases	95% Confidence Interval
11-11-2020	110266 (+2182)	[108084 - 115057]
15-11-2020	113587 (+5503)	[108084 - 124762]
18-11-2020	116133 (+8049)	[108084 - 137902]

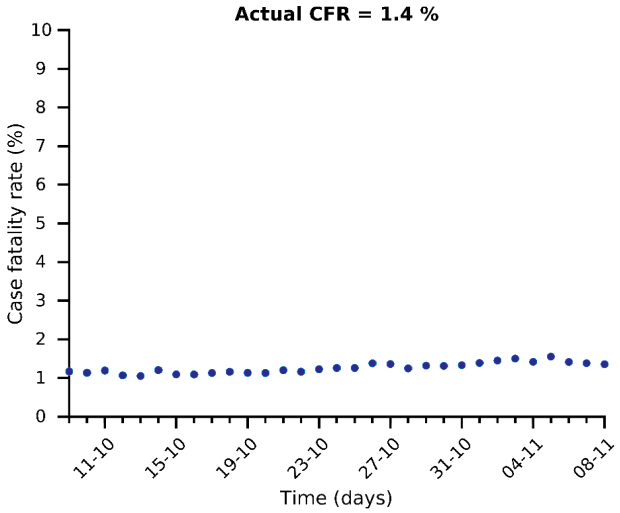
Current indicators

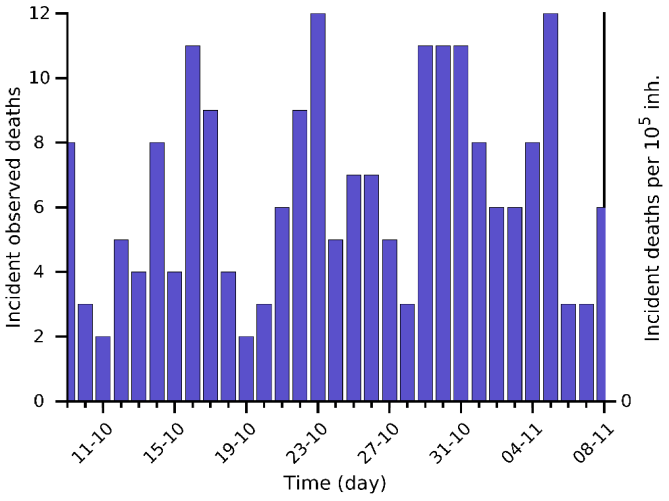
	A14	EPG	CFR	N7	D7
Today	9	11	1.35 %	896	6
A Week ago	7	8	1.39 %	677	8
Maximum	15	21	4.97 %	1581	29

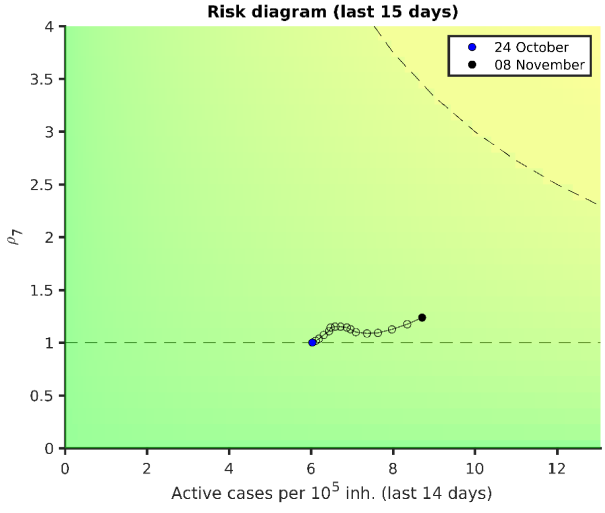




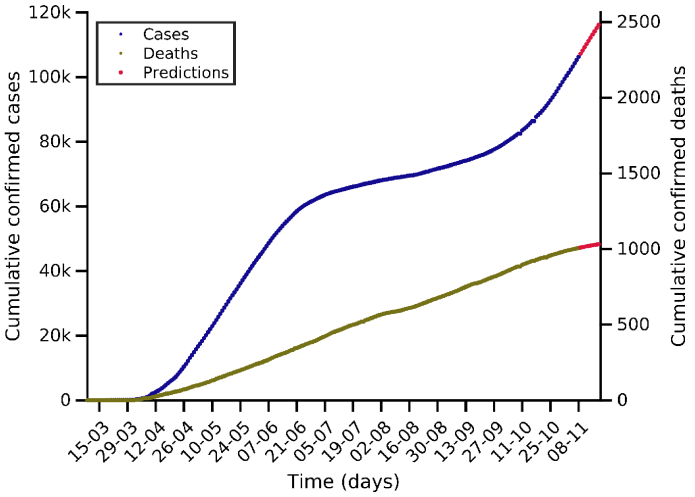








Belarus 08-11-2020. Pop: 9.4M. Cumulative incidence: $1125/10^5$

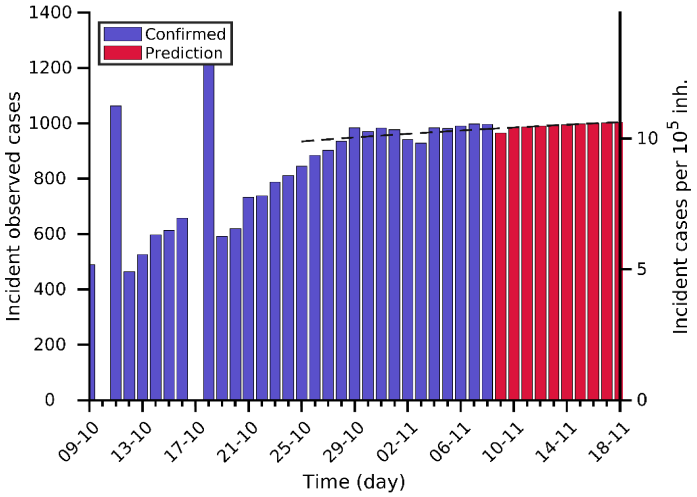


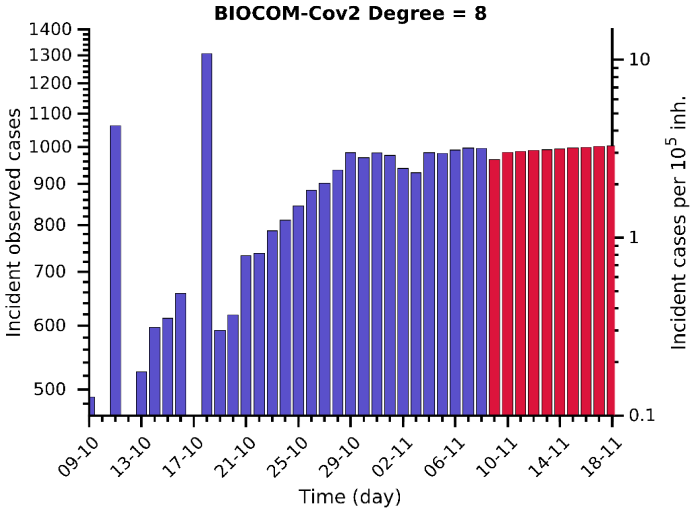
Predictions for next days

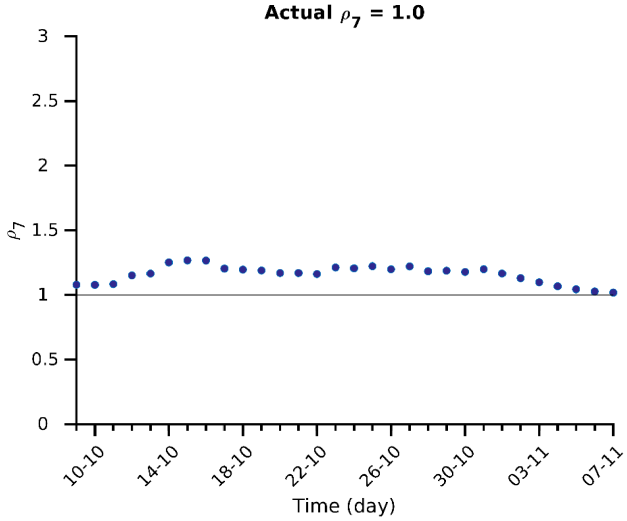
Day	Number of cases	95% Confidence Interval
11-11-2020	109216 (+2937)	[108878 - 109555]
15-11-2020	113191 (+6912)	[112428 - 113955]
18-11-2020	116196 (+9917)	[114739 - 117653]

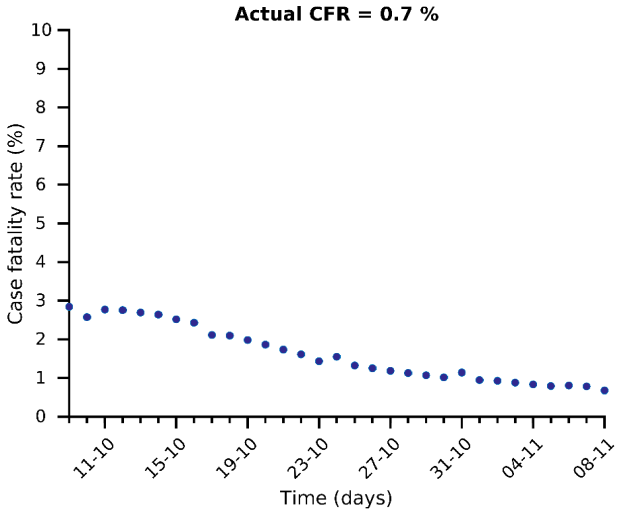
Current indicators

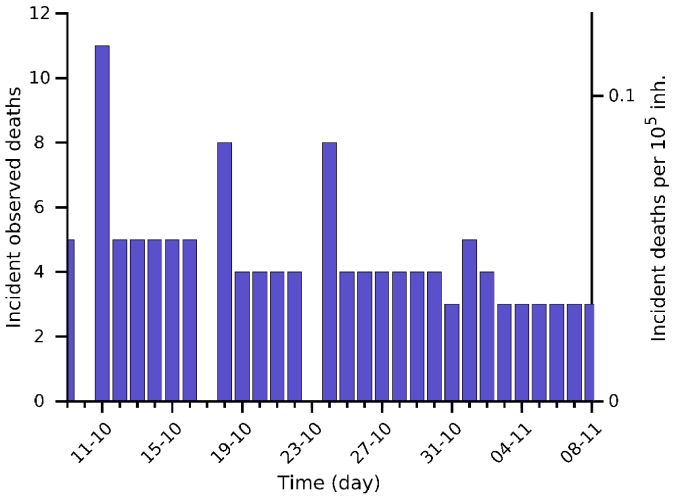
	A14	EPG	CFR	N7	D7
Today	142	145	0.68 %	974	3
A Week ago	124	149	0.95 %	948	4
Maximum	142	151	4.92 %	974	6

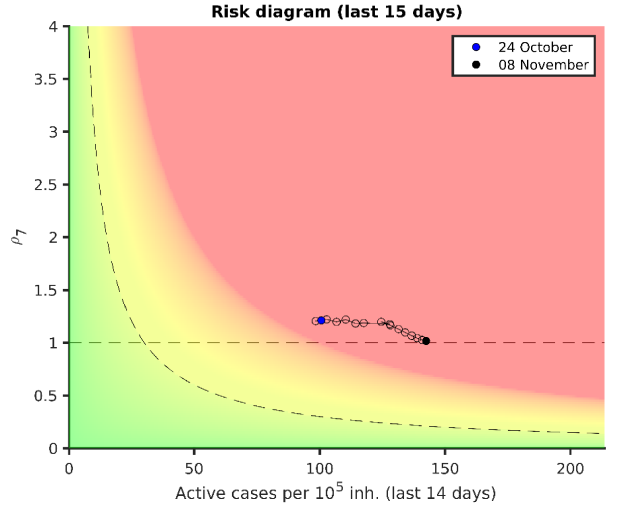




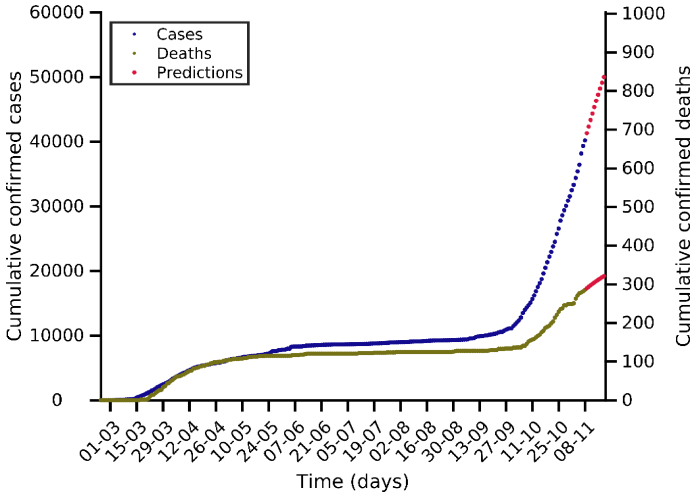








Malaysia 08-11-2020. Pop: 32.4M. Cumulative incidence: 124/10⁵

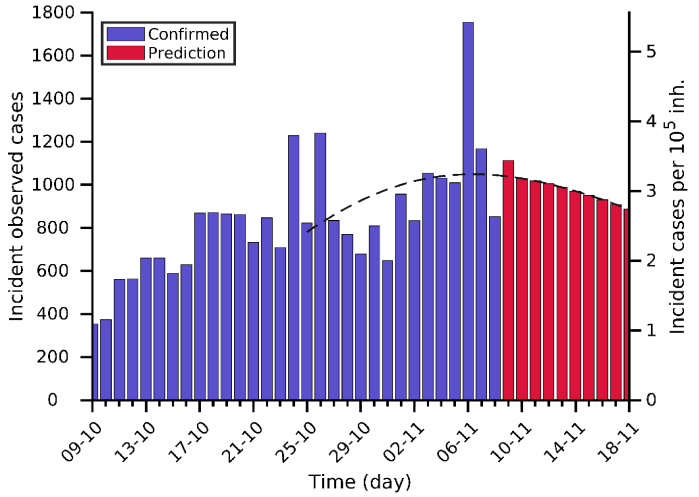


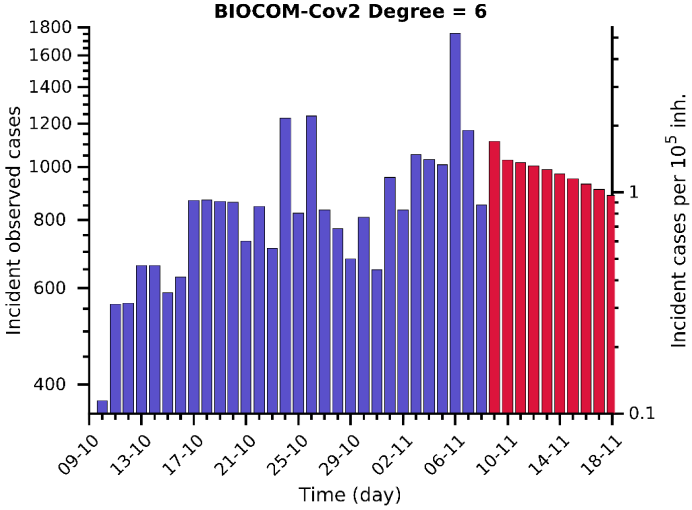
Predictions for next days

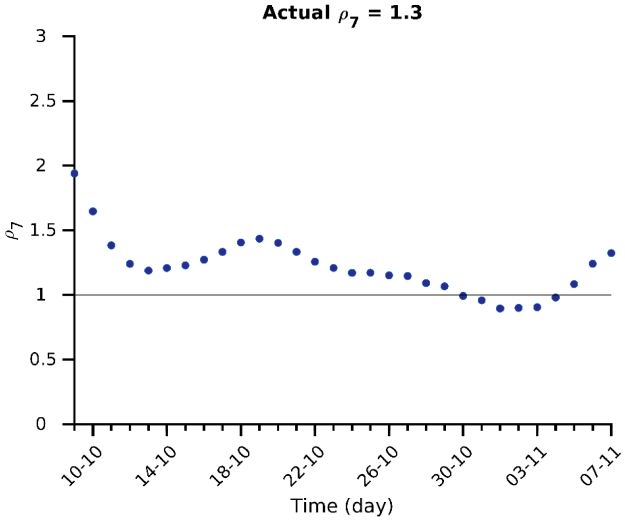
Day	Number of cases	95% Confidence Interval
11-11-2020	43371 (+3162)	[41179 - 45563]
15-11-2020	47287 (+7078)	[43111 - 51463]
18-11-2020	50014 (+9805)	[42961 - 57066]

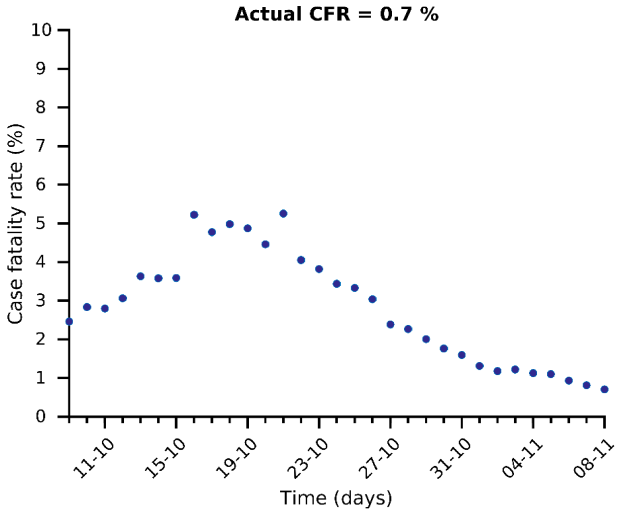
Current indicators

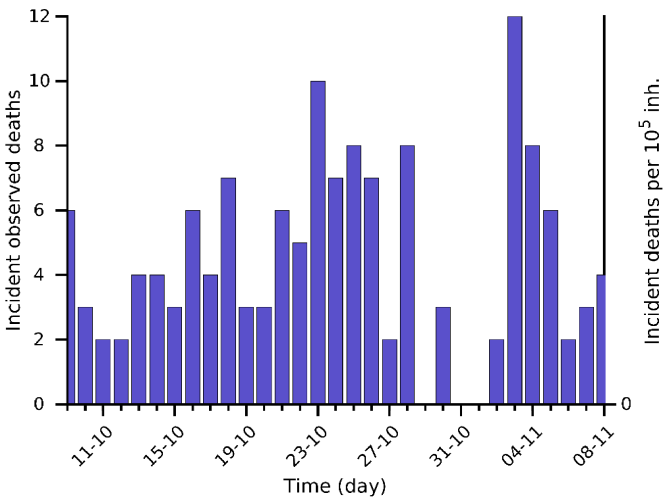
	A14	EPG	CFR	N7	D7
Today	42	56	0.70 %	1101	5
A Week ago	37	36	1.31 %	849	3
Maximum	42	56	4.98 %	1116	7

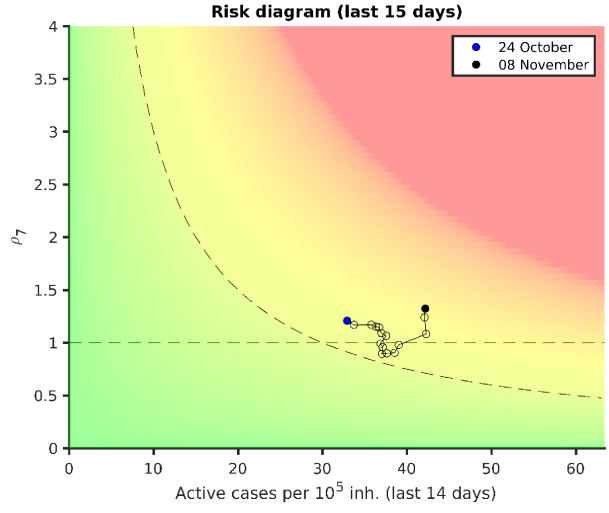




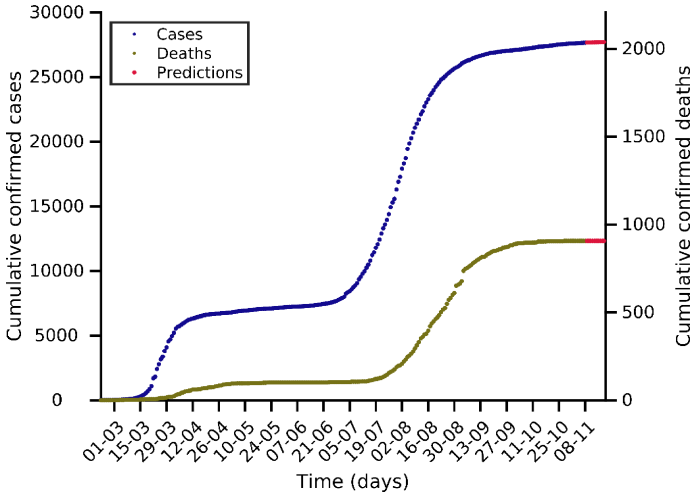








Australia 08-11-2020. Pop: 25.5M. Cumulative incidence: 108/10⁵

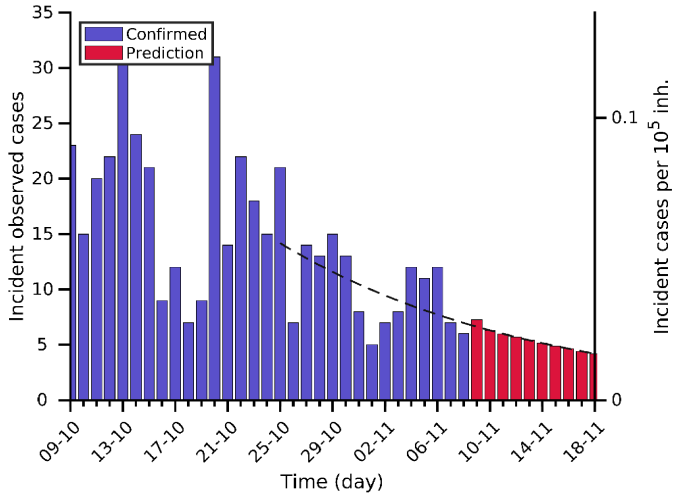


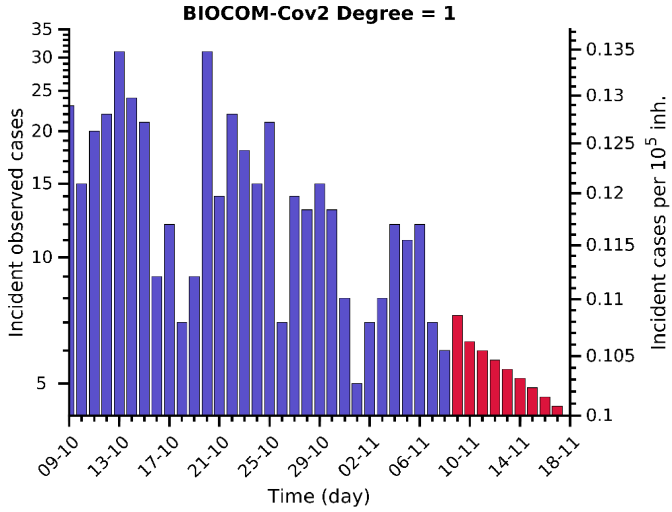
Predictions for next days

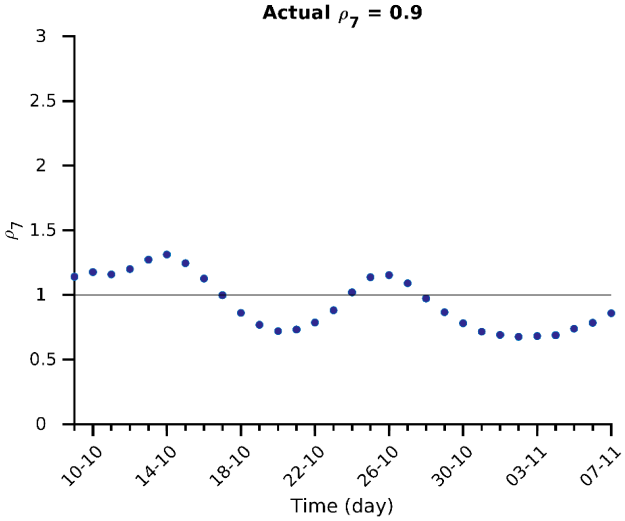
Day	Number of cases	95% Confidence Interval
11-11-2020	27678 (+20)	[27658 - 28093]
15-11-2020	27699 (+41)	[27658 - 28014]
18-11-2020	27712 (+54)	[27667 - 27757]

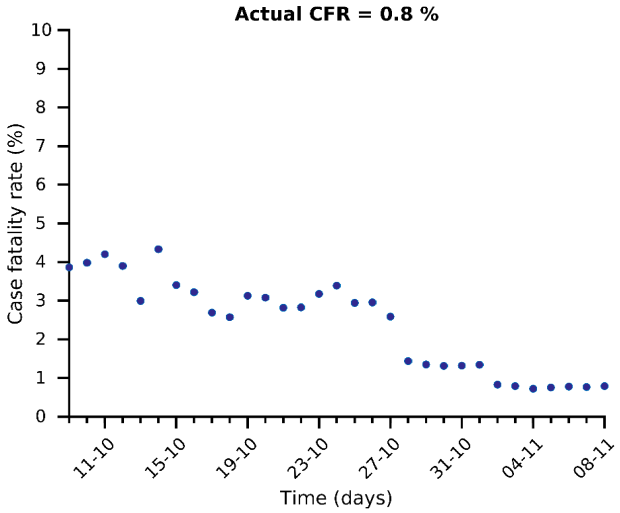
Current indicators

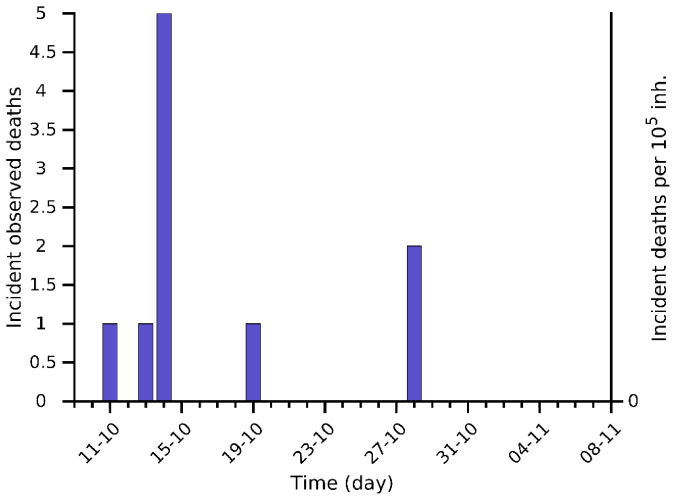
	A14	EPG	CFR	N7	D7
Today	1	0	0.79 %	9	0
A Week ago	1	1	1.34 %	11	0
Maximum	26	38	5.00 %	552	22

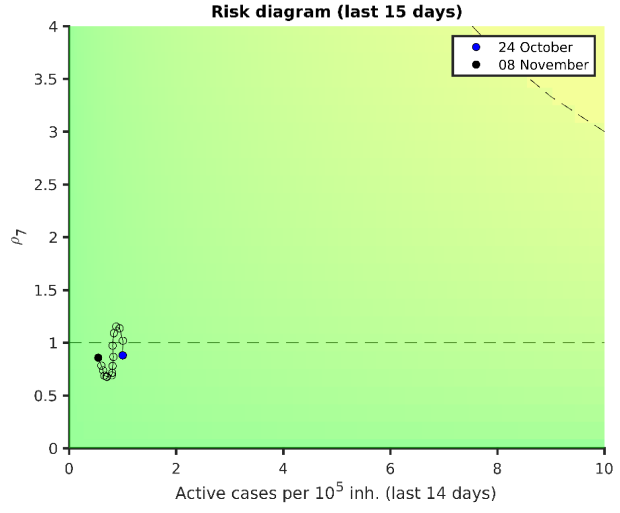




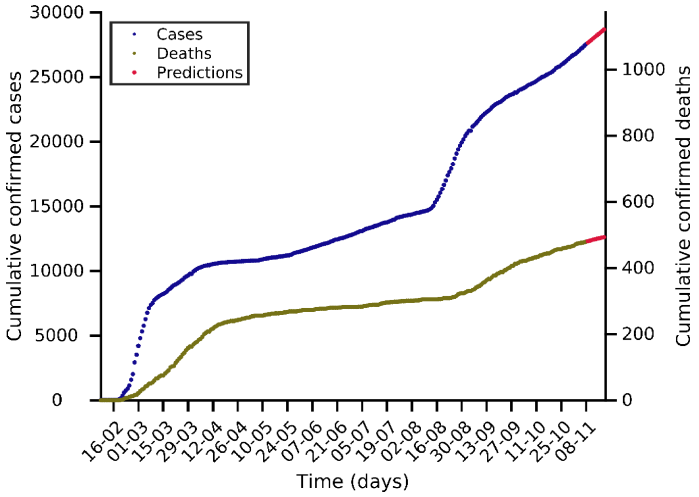








South Korea 08-11-2020. Pop: 51.3M. Cumulative incidence: 54/10^5

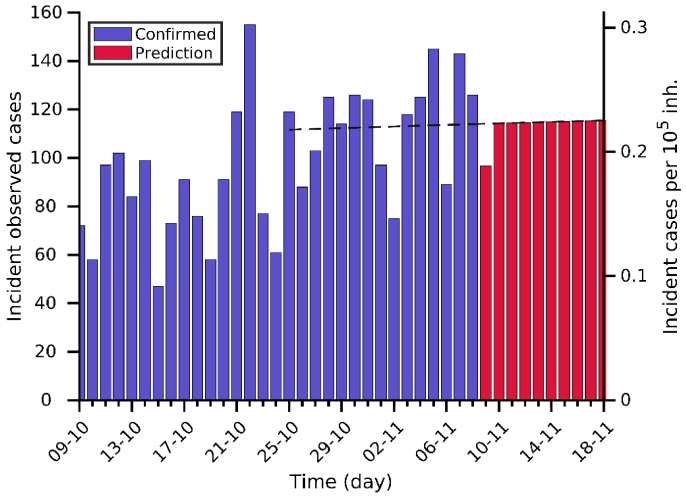


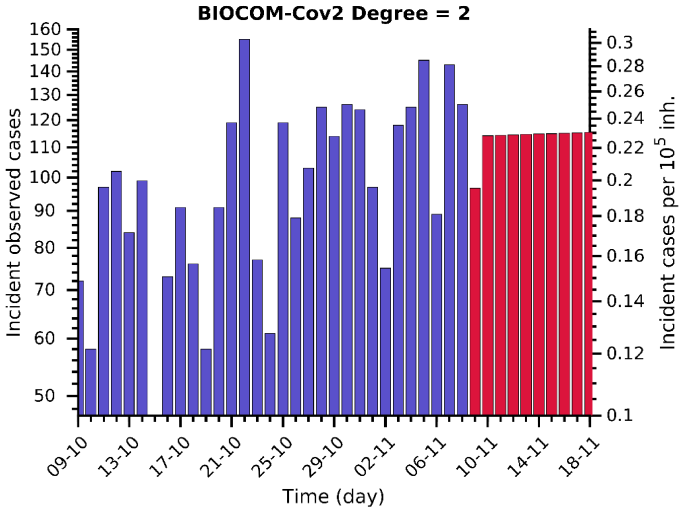
Predictions for next days

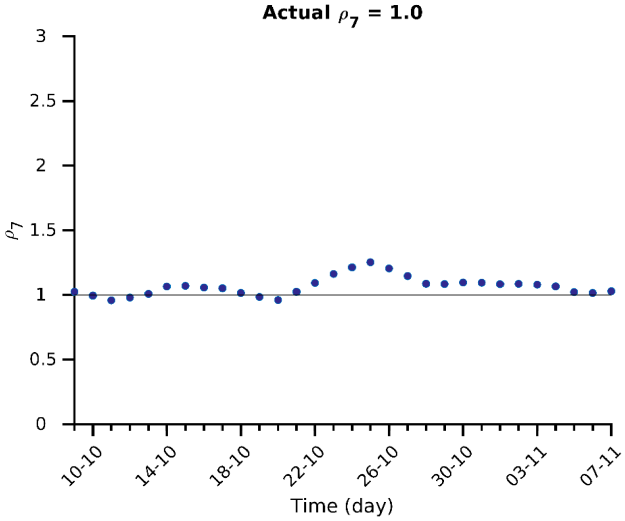
Day	Number of cases	95% Confidence Interval
11-11-2020	27878 (+325)	[27553 - 28210]
15-11-2020	28337 (+784)	[27572 - 29103]
18-11-2020	28683 (+1130)	[27553 - 30145]

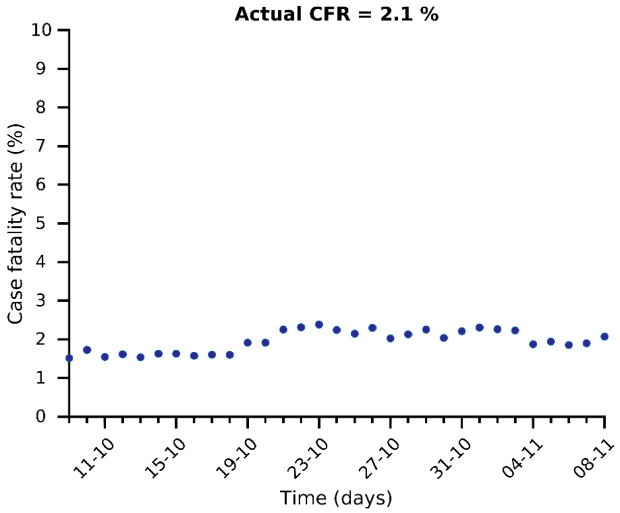
Current indicators

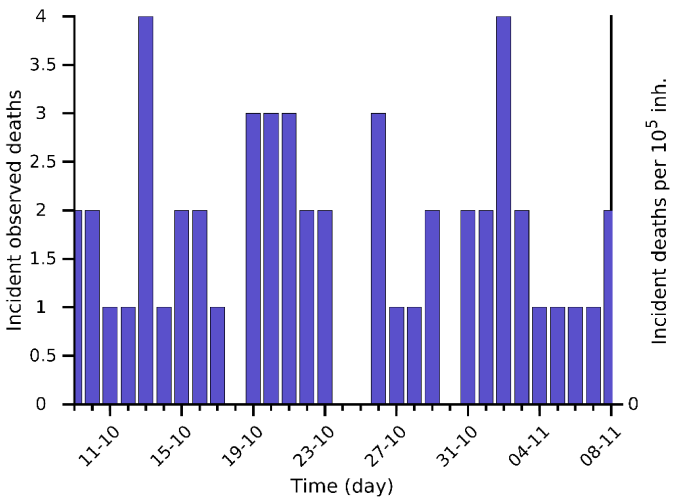
	A14	EPG	CFR	N7	D7
Today	3	3	2.07 %	117	2
A Week ago	3	3	2.30 %	111	2
Maximum	13	114	4.98 %	609	7

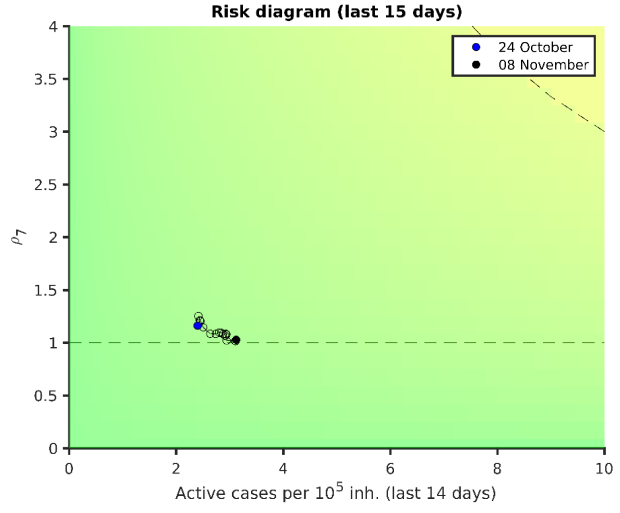












Methods

Methods

(1) Data source

Data are daily obtained from European Centre for Disease Prevention and Control (ECDC)[2] and country official sources (when indicated). Daily data comprise, among others: total confirmed cases, total confirmed new cases, total deaths, total new deaths. It must be considered that the report is always providing data from previous day. In the document we use the date at which the datapoint is assumed to belong, i.e., report from 15/03/2020 is giving data from 14/03/2020, the latter being used in the subsequent analysis.

(2) Data processing and plotting

Data are initially processed with Matlab in order to update timeseries, i.e., last datapoints are added to historical sequences. These timeseries are plotted for individual countries and for the UE+EFTA+UK as a whole:

- ✓ Number of cumulative confirmed cases
- ✓ Number of reported new cases
- ✓ Number of cumulative deaths

Then, two indicators are calculated and plotted, too:

- ✓ Case fatality rate: number of cumulative deaths divided by the number of cumulative confirmed cases, and reported as a percentage; it is an indirect indicator of the diagnostic level.
- ✓ ρ: this variable is related with the reproduction number, i.e., with the number of new infections caused by a single case. It is evaluated as follows for the day before last report (*t-1*):

$$\rho(t-1) = \frac{N_{new}(t) + N_{new}(t-1) + N_{new}(t-2)}{N_{new}(t-5) + N_{new}(t-6) + N_{new}(t-7)}$$

where $N_{new}(t)$ is the number of new confirmed cases at day *t* after applying a 7-day moving average to the new cases dataset, so that fluctuations (e.g., weekend effect) are smoothed.

(3) Classification of countries according to their epidemic level: the scale Biocom-Cov

Countries are assigned a degree in the discrete Biocom-Cov scale, which aims to facilitate a simple way of assessing the situation of the country. It is based on the level of daily new cases per 100,000 inhabitants as follows:

Pandemic degree	Daily new incident cases per 10^5 inh.
0	0
1	0-0.1
2	0.1-0.5
3	0.5-1.25
4	1.25-2
5	2-3
6	3-5
7	5-8
8	8-14
9	>14

[2] https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases

(4) Fitting a mathematical model to data

Previous studies have shown that Gompertz model[3] correctly describes the Covid-19 epidemic in all analysed countries. It is an empirical model that starts with an exponential growth but that gradually decreases its specific growth rate. Therefore, it is adequate for describing an epidemic wave that is characterized by an initial exponential growth but a progressive decrease in spreading velocity provided that appropriate control measures are applied. Once in the tail, predictions work but the meaning of parameters is lost.

Gompertz model is described by the equation:

$$N(t) = K\, e^{-ln\left(\frac{K}{N_0}\right)\cdot e^{-a\cdot(t-t_0)}}$$

where *N(t)* is the cumulated number of confirmed cases at *t* (in days), and N_0 is the number of cumulated cases the day at day t_0. The model has two parameters:

- ✓ *a* is the velocity at which specific spreading rate is slowing down;
- ✓ *K* is the expected final number of cumulated cases at the end of the epidemic.

This model is fitted to reported cumulative cases of the UE and of countries that accomplish two criteria: 4 or more consecutive days with more than 100 cumulated cases, and at least one datapoint over 200 cases. Day t_0 is chosen as that one at which *N(t)* overpasses 100 cases. If more than 15 datapoints that accomplish the stated criteria are available, only the last 15 points are used. The fitting is done using Matlab's Curve Fitting package with Nonlinear Least Squares method, which also provides confidence intervals of fitted parameters (*a* and *K*) and the R^2 of the fitting. At the initial stages the dynamics is exponential and *K* cannot be correctly evaluated. In fact, at this stage the most relevant parameter is *a*.

It is worth to mention that the simplicity of this model and the lack of previous assumptions about the Covid-19 behaviour make it appropriate for universal use, i.e., it can be fitted to any country independently of its socioeconomic context and control strategy. Then, the model is capable of quantifying the observed dynamics in an objective and standard manner and predicting short-term tendencies.

(5) Using the model for predicting short-term tendencies

The model is finally used for a short-term prediction of the evolution of the cumulated number of cases (3-5 days). The confidence interval of predictions is assessed with the Matlab function `predint`, with a 99% confidence level. These predictions are shown in the plots as red dots with corresponding error bar. For series longer than 9 timepoints, last 3 points are weighted in the fitting so that changes in tendencies are well captured by the model.

(6) Estimating non-diagnosed cases

Lethality of Covid-19 has been estimated at around 1 % for Republic of Korea and the Diamond Princess cruise. Besides, median duration of viral shedding after Covid-19 onset has been estimated at 18.5 days for non-survivors[4] in a retrospective study in Wuhan. These data allow for an estimation of total number of cases, considering that the number of deaths at certain moment should be about 1 % of total cases 18.5 days before. This is valid for estimating cases of countries at stage II, since in stage I the deaths would be mostly

[3] Madden LV. Quantification of disease progression. Protection Ecology 1980; **2**: 159-176.
[4] Zhou et al., 2020. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. The Lancet; March 9, doi: 10.1016/S0140-6736(20)30566-3

due to the incidence at the country from which they were imported. We establish a threshold of 50 reported cases before starting this estimation.

Reported deaths are passed through a moving average filter of 5 points in order to smooth tendencies. Then, the corresponding number of cases is found assuming the 1 % lethality. Finally, these cases are distributed between 18 and 19 days before each one.